SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

Copyright 1912, by Munn & Co., Inc.

"THE TWO SHOVELS"

From a Painting by Gerrit H. Beneker

Panama Canal—The World's Greatest Engineering Work

Vol. CVII. No. 19
Nov. 9, 1912

Munn & Co., Inc., Publishers
New York, N. Y.

PRICE
15 CENTS

$1475
Completely Equipped

Overland

$1475
Completely Equipped

Model 71 T

- Complete Electric Lighting Outfit, Generator and Storage Battery
- Self-Starter
- 45 Horsepower
- Q. D. Demountable Rims and extra Rim
- Timken Bearings
- Center Control
- Wheel Base 114 inches
- Brewster green body, Ivory striped, nickel plated and dead black trimming
- Warner Speedometer
- Mohair Top and Boot
- Clear Vision Wind Shield
- Prestolite Tank

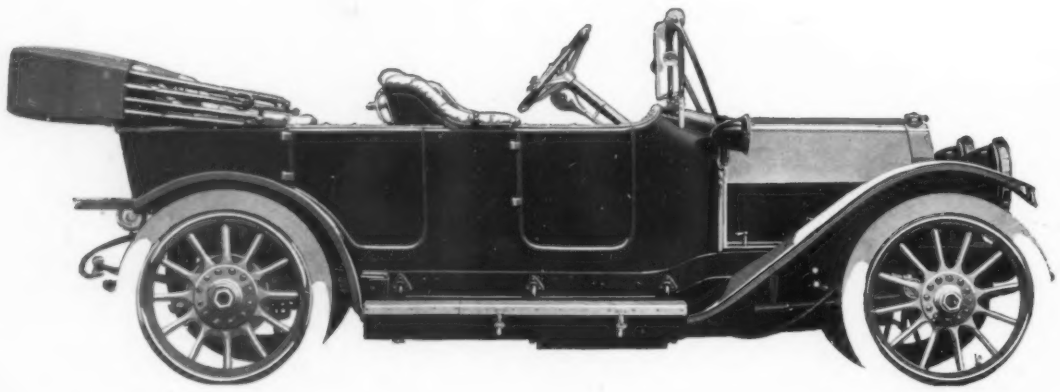
THIS car has the power of an $1,800 car; it has the strength of an $1,800 car; it has the size of an $1,800 car; it has the seating capacity of an $1,800 car; it has the wheel base of an $1,800 car; it has the chassis construction of an $1,800 car; it has the comfort of an $1,800 car; it has the finish of an $1,800 car; it has the equipment of an $1,800 car.

¶ All of which is made possible by an annual production of 40,000 cars.

¶ Handsome catalogue on request.

(Please Address Dept. 27)

The Willys-Overland Company
Toledo, Ohio

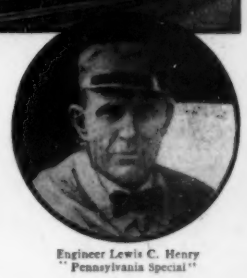


Engineer Tom Cushing, of the Chicago, Burlington & Quincy Railroad's fast train, the "Denver Limited." On one division of this road out of 211 watches in service 150 are Hamiltons.

Conductor S. L. Cowie "Pennsylvania Special"

PENNSYLVANIA SPECIAL

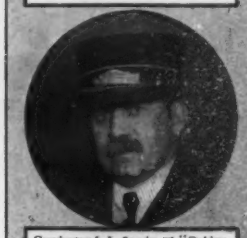
The famous "Pennsylvania Special," 18 hours between New York and Chicago. Engineers and conductors of this train have carried Hamilton Watches for years. Other photographs on this page show a few of the thousands of railroad men who for years have been using the Hamilton Watch to time their runs.



Engineer Lewis C. Henry "Pennsylvania Special"

Conductor Jacob Delil, of the Chicago, Milwaukee & St. Paul Railway, "Pioneer Limited." On one division of this road, out of 115 watches inspected 85 were Hamiltons. Cases like this are numerous.

Engineer J. Hanavan, of Lehigh Valley, the "Black Diamond" road



Conductor J. L. Servis, of "Golden State Limited," Rock Island Lines

The Fastest Trains in America Run on Hamilton Watch Time

Over one-half of the railroad men on American roads maintaining Official Time Inspection carry Hamilton Watches

If you would experience the satisfaction and convenience of owning a watch of the unquestioned precision that railroad men demand, buy

The Hamilton Watch

"The Railroad Timekeeper of America"

The Hamilton 12-size (shown here), the thinnest 19 or 23 jewel 12-size watch made in America, is sold complete only.

The Hamilton Watch is made in standard sizes for men and women and sold by leading jewelers everywhere at $38.50 to $150.00 for complete watches, timed and adjusted in the cases at the factory. In some models, movements only may be purchased, so that, using your present watch case, you can own a Hamilton Watch for $12.25 and upward. Ask your jeweler. If he can not supply you, write us.

Write for "The Timekeeper"

A book about watches that contains pictures, descriptions and prices of all Hamilton models will be gladly sent to anyone interested in the purchase of a fine watch.

Hamilton Watch Company
Lancaster, Pennsylvania

The Twentieth Century Limited of the New York Central Lines and her engineer, D. R. Woods, who has carried a Hamilton Watch for several years.

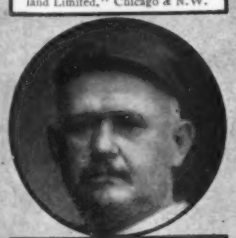
Most American railroads maintain on every division a rigid watch inspection. At regular intervals the watch of every employee of any responsibility must be submitted for examination and any watch that varies more than 3 seconds per day is ordered out of service. No railroad ever "adopts" one make of watch to the exclusion of other makes but all watches must conform to a set standard.

Engineer George Cooper, of the Chicago, Burlington & Quincy R.R.

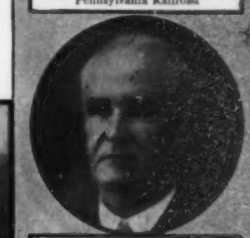
Engineer F. R. Wood, of "Gulf Coast Special," Frisco Lines

Conductor Ed. Barber, of "Overland Limited," Chicago & N.W.

Train Dispatcher J. W. Leaman, Pennsylvania Railroad



Engineer Mike Hines, of the "Colorado Flyer," Rock Island Lines



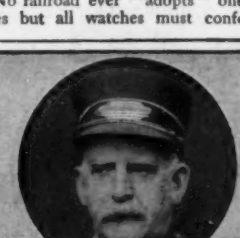
Engineer J. H. Royce, of "Twin City Limited," Chicago & N.W.

Conductor D. Kelly, of the "Commercial Limited," Burlington Route

Engineer Rush A. Eddy, of "Black Hills Limited," C. M. & St. P. Ry.

Engineer C. S. Conklin, Chicago & Alton "Hummer"

Engineer John Kryselmier, Missouri Pacific Railroad

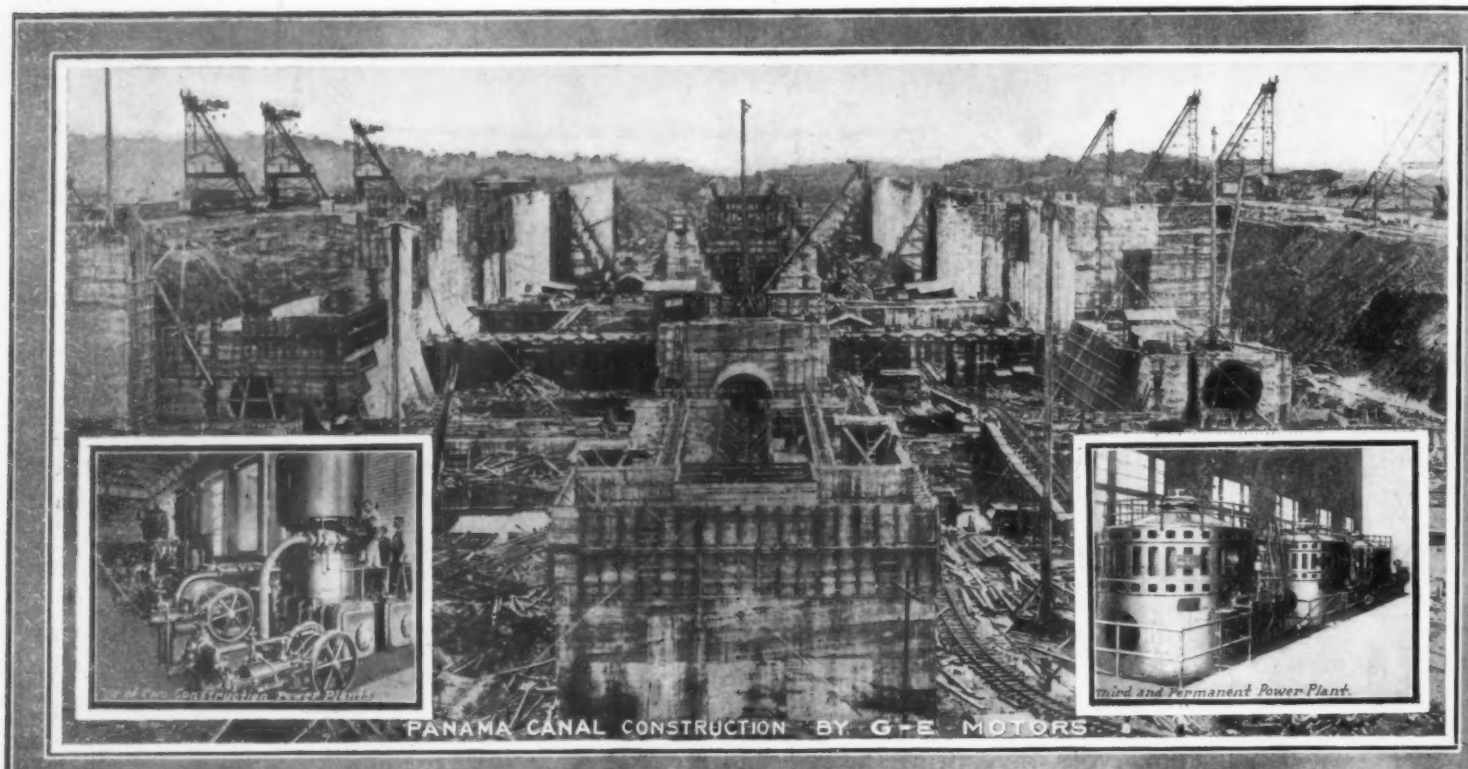


Conductor C. Smith, Chicago & Alton "Hummer"

Engineer D. E. Conley, Chicago & Eastern Illinois "Fast Mail"

Engineer H. P. Maybee, of the Erie Railroad

Cond. V. H. Sallday, "Chicago-Denver Limited," Burlington Route



Why Electric Power Was Selected

Electric power is playing an important part in the construction of the Panama Canal. It will be used to operate the completed canal.

A glance will show the magnitude of the completed canal and also how and why electric power is being used.

The Panama Canal is ranked as the greatest engineering feat the world has ever undertaken. It will be 50 miles long and vary in width from 300 feet at Culebra Cut to 1000 feet at Gatun Lake. Three locks at Gatun raise its level to 85 feet above the sea, one at Pedro Miguel lowers it 30 feet and two at Miraflores 55 feet more to sea level at the Pacific end.

Building the Canal

Water for a large part of the hydraulic excavation and fillings necessary for the canal and mammoth Gatun dam has been supplied by pumps driven by electric motors.

Both here and on the Catskill Aqueduct G-E motor driven pumps have proven absolutely dependable even though working under adverse conditions. Each motor can be controlled by push buttons from remote locations if desired. This system requires but a small part of one attendant's time and does not draw upon the supply of compressed air or steam so necessary for drills at the workings. This method of operating pumps has proven so dependable and economical that American cities are using it in water plants. A number of cities are depending entirely upon electric pumps for their water supply.

Practically all the millions of yards of concrete used in the canal construction have been mixed by electric power and in many cases the cement, sand or broken rock has been crushed, unloaded, stored or conveyed by electric cars and G-E electric locomotives.

Electric concrete mixers can be moved quickly to a new location because of the elimination of all weight not needed for strength, and the absence of a massive boiler. When relocated a simple electrical connection again permits operation with no delay.

There is no waiting to get up steam, no extra weight to drag around, and the motors consume current only when they are working, thereby effecting power economy. Some of the advantages which determine the selection of General Electric motor drive in preference to the old donkey engines are: No water to be carried, no smoke nuisance, no fire risk, no firemen, no licensed engineer and no watchman. These advantages apply equally well in many cases to cranes, unloaders, etc.

On the Atlantic Division the mixed concrete is placed in the forms by electrically operated cableways which span the enormous cut or "prism" necessary for the canal. These cableways are operated with greater speed and certainty by the G-E motors and control devices used than is possible with other forms of motive power, which unduly tire the operator.

On the Pacific Division concrete is placed by electric cranes of fixed cantilever, berm and chamber types as they move in the canal prism.

Electric power for all this construction work, the electric lighting and the searchlights used for night work on the Gatun cableway unloaders, etc., is furnished by two Curtis Turbine power stations.

Due to the intermittent character of most of the operations used in construction work, the demands upon an electric power station fluctuate, rapidly between quite wide limits. Curtis Turbines give a high economy throughout a wide range of loads and so are eminently fitted for this work. These turbines benefit fully from high steam pressure including superheat.

The vacuum maintained is 28 inches, something not generally considered possible in tropical countries with condensing water of 80° F. and upwards. The advantages of the high vacuum used are completely realized. These turbines are constructed to withstand sudden changes of temperature incident to quick starting or to variations in superheat while running.

Permanent Operating Equipment

The entire operation of the canal will be by electric power furnished from a water power plant at the Gatun Spillway and from the Miraflores Curtis turbine section which will be maintained as steam auxiliary.

Electric power permits the control of all machinery at each group of locks from one lookout tower. The great flexibility possible from its use was the prime factor in determining the selection of electricity as a motive power.

The windings of the generators used in these stations are thoroughly protected from the effects of the moist tropical climate, by high grade insulation which was specially developed for the extreme conditions prevailing on the Canal Zone. They are built to run very cool and have the perfected G-E design features which are found in many of the largest power stations of the world.

Over a thousand electric motors will be used to operate the locks, gates, dams, gate protecting chains and to tow the ships through the canal by electric locomotives. Four powerful electric locomotives will move each ship through the canal. A sample locomotive is now under construction by the General Electric Company.

All the range lights will be electrically lighted, and the telegraph, telephone, fire alarm system and mining batteries offer additional opportunities for electricity to demonstrate its reliability.

Thus all the electric power used for building the canal and operating it when finished will be furnished by generators built by the General Electric Company. Practically all the electrical equipment purchased for the permanent operation of the Panama Canal was furnished by the General Electric Company.

General Electric Company

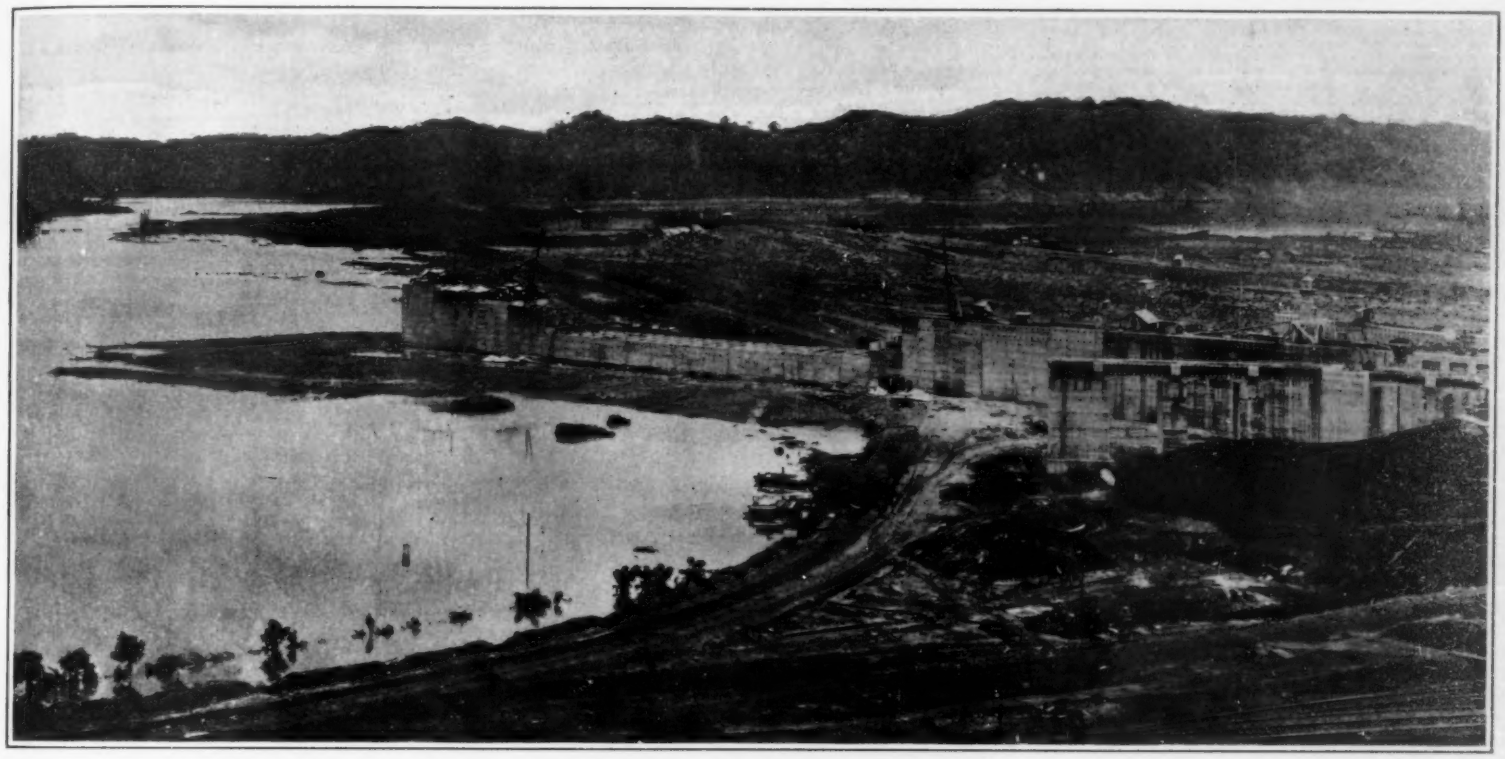
General Office: Schenectady, N. Y. 3853 **Sales Offices in All Principal Cities**

SIXTY-EIGHTH YEAR

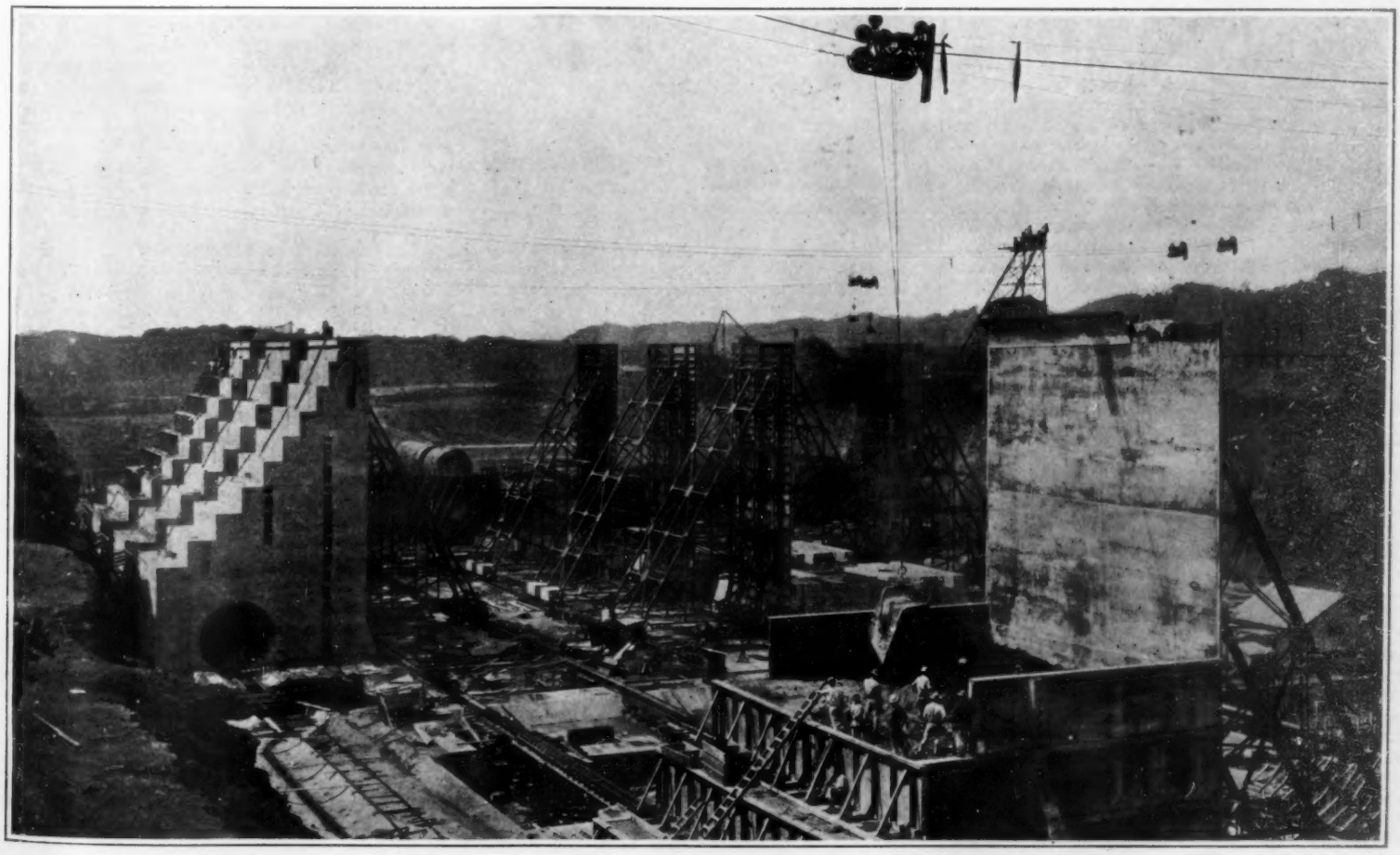
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CVII. NUMBER 19. ★ NEW YORK, NOVEMBER 9, 1912 ★ PRICE 15 CENTS $3.00 A YEAR



Gatun Dam—General view from water tower, showing south center approach wall, forebay of upper locks, the dam in process of construction, and the lake forming above the dam.



Constructing sidewall monoliths of the upper lock, Gatun. The concrete was placed between steel forms, movable on tracks laid on the floor of the locks.

THE GATUN DAM AND LOCKS.—[See page 386.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, NOVEMBER 9, 1912

Published by Munn & Co., Incorporated. Charles Allen Munn, President
Frederick Converse Beach, Secretary and Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Copyright 1912 by Munn & Co., Inc.

Subscription Rates

Subscription one year $3.00
Postage prepaid in United States and possessions Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid, ... 3.75

The Scientific American Publications

Scientific American (established 1845) . . . . . per year, $3.00
Scientific American Supplement (established 1876) , " 5.00
American Homes and Gardens . . . . . " 3.00
The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Man

WE speak elsewhere on this page of the special appliances which have contributed so greatly to the early completion of the Panama Canal. But what about the "man behind the" machine? No matter how great the excellence of an engineering plant, its output may be easily cut down by inefficient handling and a faulty organization of the working force. It took nigh upon forty thousand men to build the canal, and of this veritable army only a scattered few were natives of the soil. Literally, this was an army of invasion, carrying its attack into a country situated two thousand miles from its base. Not alone the men themselves had to be carried to a far distant and unfavorable field, and strewn out on a working front fifty miles in length, but with them had to be carried practically the very homes in which they were housed; and day by day the commissariat and quartermaster's department have had to forward from the United States, and distribute, the food and general supplies necessary for their maintenance at the front. In view of these facts, shall we be stretching the point too far when we say that the conquest of the Isthmus of Panama is a feat of the arms of peace, as brilliant and as difficult as any ever accomplished by the arms of war?

Continuing to speak in the terms of our analogy, it must be admitted that in its opening days, the campaign was not marked by that brilliant success which has distinguished its later phases. The period of civilian control was marked by doubt and disappointment. Wallace and Stevens, engineers of brilliant achievement, were beset with many difficulties, of which not a few were quite unnecessary. Chief among the latter was the hampering system of control, largely from Washington, which left these men without that absolutely free hand which is necessary for the successful execution of a work of this difficulty and magnitude. To both of these men, and particularly to Stevens, is credit due for working out a plan of organization which has contributed largely to the success of the work. But there was a lack of co-operation and absolutely unhampered central control which, if it did not threaten the ultimate success of the work, certainly promised to extend the time of its execution to an unconscionable length. The resignation and return to the United States of two civilian chief engineers in rather close succession presented an emergency which it took the clear insight and quick judgment and action of ex-President Roosevelt to grapple with successfully. He decided to place the whole work under army control, and thus subject it to an iron discipline against which there could be no appeal. Fortunately, he found in the Corps of Engineers of the army a highly expert body of men, who were already possessed of wide experience in works of civil engineering of a character generally similar to that at Panama. Need we go any further in this historical review? The fact that the canal will be ready for traffic over a year ahead of the time appointed, tells the story of the army's successful handling of this, the world's greatest engineering work.

In spite of some belated criticism, to which we do not attribute much value, it is generally agreed that one of the finest accomplishments of the Japanese people in the war with Russia, was their successful handling of the problem of sanitation. So, also, in this more peaceful but not less difficult campaign at Panama, the cleaning up of the Canal Zone, and the extirpation and control of tropical fevers, as carried out under Col. Gorgas, must ever be considered as great an accomplishment in the field of sanitation as is the actual digging of the canal in the broad field of engineering. Not alone did the work of Col. Gorgas and his staff pave the way for the construction of the canal, but they have given an object lesson to the tropics in healthful living, whose benefits will be felt throughout the whole belt of the equatorial zone as long as time endures.

It was fortunate for the success of the enterprise that when Col. Goethals was placed in control as chairman of the Isthmian Canal Commission and chief engineer of the work, he was allowed to have such absolute control that he has himself spoken of his rule as a "benevolent despotism." To the vast advantages of army organization and discipline Goethals added all the force of an unusually strong personality. His enthusiastic devotion to the enterprise, coupled with a magnetic personal interest in the working force, have found a quick response among the men—engineers, mechanics and laborers alike, who have so loyally co-operated to push the great work so rapidly to its completion.

The Machine

THE predicted completion of the Panama Canal some fifteen months earlier than the date originally estimated, is a distinct tribute to the efficiency of American labor-saving machinery as exemplified in the steam shovel, the plow unloader, and the high-speed cableway. Other labor-saving devices, it is true, have contributed to the great result; but so far as the mechanical appliances at the canal are concerned, the three named above stand out as giants among their fellows. Outside of the problem of sanitation, the solution of which when the United States took hold of the job was immediately recognized as imperative if the canal was ever to be built, the difficulties of the task were rather those of quantity than of quality. In spite of much that has been said to the contrary, particularly in the early days of our occupation, when disappointed engineers and contractors did not hesitate to say that the construction of the canal at Panama was fairly bristling with engineering difficulties of a new and altogether untried character, it is a fact that, judged from the engineer's standpoint, the work at Panama differs from the general run of hydraulic and excavating problems in the United States only in respect of its magnitude and of the trying climatic conditions under which it is carried on. In one respect indeed, that of financial backing, the work of the builders of the canal has been rendered much easier than similar work of an engineering character as carried on at home. Requisitions for men, materials, and money have met with instant and liberal response from Congress; and just what this means will be well understood by those engineers who have had charge of important contracts, city, State or otherwise, in which the element of rapid construction was given prime importance.

At the very outset of the work, it was realized that the two controlling sections as regarded the time of completion were the Culebra cut and the locks and dams at Gatun. The former was a question of rapid excavation and speedy and uninterrupted disposal of the spoil. The latter was a question of the rapid handling, mixing and laying in place of the largest amount of concrete that had ever entered into a single job of this character. It was predicted, at first, that the cut would be finished before the locks, and it was believed that the latter could not be completed in time to allow of an earlier opening of the canal than January 1st, 1915. Because of the unprecedented dimensions of the locks, the engineers realized at once that existing cableways and other means of transport possessed neither capacity nor speed commensurate with so great a task. The old designs which had done such good work on the Chicago Drainage Canal were redrawn and dimensions and speeds were greatly increased. The work of concreting was no sooner in full swing, than it became evident that the locks would be finished a year or two before the date originally set. With the new handling facilities, the rock, sand and cement and mixed concrete were swung to and fro in mid-air in buckets of three to five tons capacity and at speeds of twenty miles an hour and over. In a single day, and for days together, an average of three thousand yards of concrete was laid, the total on more than one occasion reaching four thousand yards.

What the cableways accomplished at the locks in expediting the work was equaled if not surpassed by the work of the steam shovel and the plow unloader at Culebra cut. Not only were the largest shovels capable of taking out five to six tons at a scoop, but these machines were pushed closer to the limit of their endurance than is ever attempted in the United States. The time element was the controlling factor. Because of heavy overhead charges, it was realized that wear and tear of plant was a small consideration where months and even years of time could be saved.

The problem of disposal of the excavating material was as great as, if not greater than, that of digging it out, and from Culebra alone 160 loaded trains per day, involving the services of 115 locomotives and two thousand cars, were hauled to the dumps, a distance from one to thirty-three miles from the point of excavation. Here, that other ingenious invention, the plow-unloader, performed admirable service. Trains of twenty-one cars, carrying six hundred tons of material, were swept clear of their loads in from four to six minutes time. Such methods of digging, loading and unloading, coupled with a most admirable track layout, soon showed their effect in the total yardage handled; and it was not long before the material was being dug out and dumped at the rate of from 3,000,000 to 4,000,000 cubic yards per month. Had it not been for the unexpected developments of the slides, the whole of the excavation in the great cut would have been finished at the beginning of the present year. The steam shovel, the dirt train, the unloader, and the overhead cableway have established a record for the Panama Canal which will probably remain for many a decade to come.

The Proof of the Pudding

TO the bacteriologists of the Bureau of Chemistry, we commend a paper which appears in the *Journal* of the American Medical Association for October 26th, 1912, from the pen of Dr. W. T. Sedgwick, the professor of Biology and of Public Health in the Massachusetts Institute of Technology. We are aware that this suggestion is not likely to be received with enthusiasm; for Prof. Sedgwick has long been opposed to the wholesale destruction of foods because they are merely of inferior quality and has insisted that Government supervision should preserve and make safe such products. Moreover, we can see immense possibilities in cunningly twisting Dr. Sedgwick's article on "The Fallacy of Testing Food Materials by Animal Inoculation" into a hearty recommendation to eating rotten eggs and a splendid indorsement of putrid food in general.

The point that Dr. Sedgwick makes in his paper is simply this: A food is not necessarily unfit to eat because, when injected beneath the skin, it may kill an animal. Although Dr. Sedgwick does not say it, we have no doubt that subcutaneous injections of many pure foods would prove fatal to lower animals. Every physician knows that a quantity of morphine which, taken hypodermically, would kill very quickly, can be swallowed with impunity. The toxins of diphtheria, tetanus, typhoid, and other infections act either comparatively feebly or not at all when taken by the mouth. So, too, the germs of lockjaw and anthrax, two of the worst diseases that afflict the human race, can be eaten; but they may not be injected with the hypodermic needle without incurring terrible results.

In face of all this, in face of the fact that the purity and salubrity of drinking water is no longer determined by injection, "certain Government bacteriologists," as Prof. Sedgwick euphemistically refers to the Bureau of Chemistry's pseudo-scientists, seek to revive this discredited "test"—not only for water, but for eggs, oysters, ice cream, gelatines, and other condiments.

Prof. Sedgwick is probably the last man who would advocate the eating of decomposed eggs, or would himself prefer a cold storage egg to the "newly laid" of the barnyard fowl. But he cannot refrain from arguing that the long experience of the trade and of consumers of eggs, particularly of those bakers who have used cold storage eggs in pies, cakes, and custards, without perceptible injury and with results no different from those obtained with fresh material, should not be brushed aside in favor of the data obtained by a scanty and questionable experimentation which consists not in feeding animals as man is fed, and not after cooking the food, but in directly injecting large amounts of the raw and uncooked substance beneath the skin or into the delicate peritoneal cavities.

The alimentary canal is very ingeniously designed. Special walls prevent the absorption of the undesirable components of foods, leaving to the intestines the task of casting them out. Not only does cooking profoundly affect food, destroying as it does most bacterial life, not only does the stomach chemically change food, raw as well as cooked, but the direct injection of raw food into the body beneath the skin becomes, as Prof. Sedgwick says, "a crude and severe procedure, a kind of rough surgical interference, totally different from the normal taking of the same materials into the body by way of the food tube—perhaps already cooked." To determine the fitness or unfitness of an egg or an oyster it must be swallowed. The proof of the pudding, in other words, lies in the eating. If an animal dies because it has been inoculated with food, no scientific light is shed on the purity or healthfulness of the material injected. Besides, a vast quantity of food is destroyed which in these days of the high cost of living can ill be spared.

Fortifying the Canal

A Legal Right and a Matter of National Expediency

By Henry L. Stimson, Secretary of War

WHEN President Taft first urged upon Congress the necessity of fortifying the canal, criticism was made that such action would be a breach of our obligations to Great Britain under the Hay-Pauncefote treaty. The publication, however, of the correspondence between Mr. Hay and Lords Pauncefote and Lansdowne completely silenced this criticism; and I do not think that our legal right to fortify the canal is now seriously questioned. It may, nevertheless, be well to summarize briefly this legal situation.

I. Our Legal Right to Fortify the Canal.

In the Clayton-Bulwer treaty of 1850 the United States and Great Britain expressly agreed not to fortify or assume any dominion over any part of Central America where the canal might be made. The first draft of the Hay-Pauncefote treaty of February 5th, 1900, contained a similar prohibition to the effect that "no fortification shall be erected commandng the canal or the waters adjacent." This proposed treaty in this form was rejected by the Senate for the very reason that it did not give the United States sufficient liberty of action in regard to the canal. The present Hay-Pauncefote treaty was then negotiated, which in its first article entirely abrogated the old Clayton-Bulwer treaty, and also omitted the restrictions against fortification which had been contained in the first proposed Hay-Pauncefote treaty.

The memorandum which Mr. Hay sent to the Senate with the second Hay-Pauncefote treaty, containing the correspondence between himself and Lords Pauncefote and Lansdowne, shows that these changes were made for the express purpose of permitting the United States to fortify and defend the canal, and that Lord Lansdowne fully understood and recognized this right on our part. As to this, Lord Lansdowne expressly said:

"It is most important that no doubt should exist as to the intention of the contracting parties. As to this, I understand that by the omission of all reference to the matter of defence, the United States Government desires to reserve the power of taking measures to protect the canal, at any time when the United States may be at war, from destruction or damage at the hands of an enemy or enemies."

The Congress of the United States then proceeded the following year in the Spooner act (Section 5) to authorize the President to enter into the contracts for the construction of the canal and its "defences." And in the following year, 1903, Mr. Hay, the same statesman who had negotiated the Hay-Pauncefote treaty, negotiated a treaty with the Republic of Panama by which Panama granted to the United States for the purpose of the canal the use, occupation and control of the present Panama Canal Zone, and also granted to the United States for the protection of such canal, the right to use its land and naval forces and to establish fortifications. (Bunau Varilla treaty, Article XXIII.)

The Hay-Pauncefote treaty and the Bunau Varilla treaties are the only existing treaties entered into by the United States which affect its rights over the Panama Canal. It is perfectly clear, therefore, from the foregoing facts, that none of the statesmen, either of Great Britain or Panama or the United States, who were concerned at the time in the negotiation of these treaties or the enactment of legislation to make them effective, had any doubt as to the right or purpose of the United States to defend and fortify the canal.

II. The Necessity of Fortifying the Canal as a Matter of National Expediency.

There has also been much misconception as to the expediency of fortifying the canal as a national policy. It has been earnestly argued that the safety of the canal can be better and more cheaply assured by an agreement between the leading nations, making it a neutral waterway and forbidding it from ever being blockaded or seized in time of war. It is argued that such a course will relieve us from the expense and burden of defending the canal, and that it will at the same time accomplish every result which we could accomplish by defending it ourselves.

This is an entire misconception. It loses sight of the vital difference between an American canal and an international canal. It loses sight of the fact that it is of vital importance to this country not only that the canal shall be open to *our* fleet in case of war, but that it shall be closed to the fleet of our enemy. An international canal, kept open and defended by agreement between the powers, from its very nature would have to be open to our opponent as well as to ourselves.

Let us look into this a little more in detail. The Panama Canal, when completed, will shorten the distance between our east and west coasts from 13,000 miles to 5,000 miles. The long peninsula of South America, stretching down nearly into the Antartic Ocean, offers an almost insuperable obstacle, not only to the transfer of our own fleet from one coast to another, but to a similar transfer of an enemy's fleet. In these days of dependence upon coaling stations, it would be almost impossible in time of war for the fleet of a nation to which such stations were not available to pass around that long and sparsely inhabited coast. Thus, the populous cities in our eastern coast are almost absolutely protected against sea raids from an enemy in the Orient. And similarly the great cities of our western coast are protected against the forays of a European fleet. To a peaceful national like our own, maintaining a very small regular army, this condition is most important. In case of war it enables us to concentrate our entire defence upon the threatened side, and it thereby tends to give us the absolutely necessary time which will be required in order to create and train a citizen army. Our regular army is insufficient in size even to protect adequately one frontier. If it had to cover two, its efficiency would be reduced

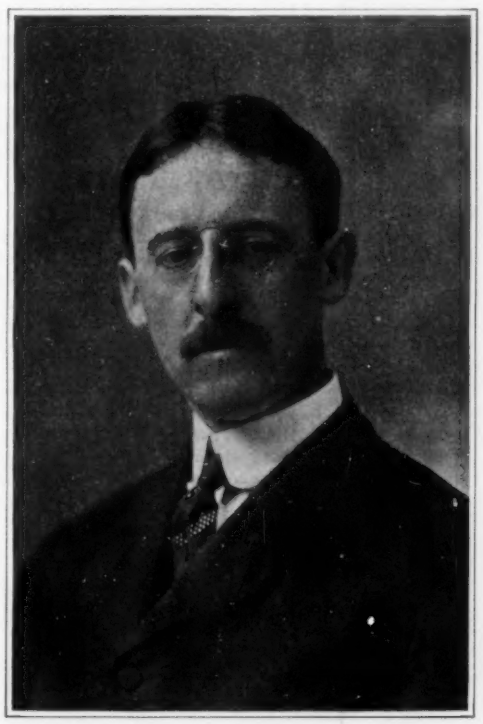


Photo. by Pach Bros.

H L Stimson

by half. The three months which would be consumed by a foreign enemy in going around Cape Horn, or through the Straits of Magellan, might make the difference between a successful defence or complete disaster on the part of those communities against which the attack was intended.

On the other hand, if, in case of war, our enemy's fleet were free to pass through the Isthmus of Panama and to transfer its activities from coast to coast at will, we should be in a very much more defenceless position than we are to-day without the canal. That very possibility would make necessary additional expenditures on our military and naval establishments which would far exceed the cost of fortifying the canal.

It is this feature of the canal which has been almost wholly lost sight of in the discussion as to fortification. We have all been quick to realize the immense naval advantage which the canal is to ourselves. Ever since the voyage of the "Oregon," we have all readily seen how the existence of the Panama Canal in case of need may be equivalent to doubling the size of the American fleet. We have not borne in mind the similar advantage which the canal, if open, would be to our enemy. We have not remembered that it would destroy the tremendous protection which the continent of South America is to us at the present day. We have not remembered that it would be almost as long a step toward depriving us of our insularity, and bringing us into the embroilments of European and Oriental nations, as the invention itself of steam navigation.

It is interesting to follow in the development of the treaties and legislation in respect to the canal, how slowly this idea developed even on the part of those responsible for the government of the country. In 1850, when the Clayton-Bulwer treaty was negotiated, the paramount interest of the United States in the proposed canal was not recognized in the treaty. Our Pacific Coast had only just been opened for settlement. The whole structure of the treaty admitted an equal interest on the part of England with ourselves in the canal. The treaty expressly provided that, even in case of war between Great Britain and the United States, the waterway was to remain open to both belligerent parties. The great development of the United States as the dominant western power, and its modern supreme interest in the Caribbean Sea, were apparently undreamed of.

Even in 1900 the first draft of the Hay-Pauncefote treaty failed to grasp and define this cardinal fact. While that treaty paved the way for this country to incur the expense of building the canal, it did not secure the vital *quid pro quo* which that expenditure merited. It did not take the decisive step which made it an American rather than an international canal. We owe it to the Senate that this result was finally secured, and that Great Britain was brought to recognize that while the canal was a great commercial convenience to the rest of the world, to us it was a vital military asset. That this recognition was clearly and frankly and cheerfully made is evidenced by Mr. Hay's notes of the negotiation subsequently transmitted to the Senate, in which he says, in respect to the omission from the second Hay-Pauncefote treaty of the words, "in time of war as in time of peace:"

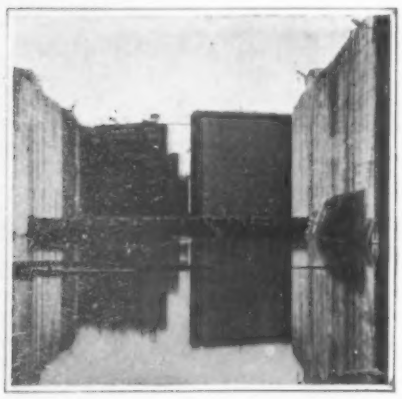
"No longer insisting upon the language of the Davis amendment, which had in terms reserved to the United States express permission to disregard the rules of neutrality prescribed, when necessary to secure its own defence, which the Senate had apparently deemed necessary because of the provision in Rule 1, that the canal should be free and open 'in time of war as in time of peace' to the vessels of all nations—it was considered that the omission of the words, 'in time of war as in time of peace' would dispense with the necessity of the amendment referred to, and that war between the contracting parties, or between the United States and any other power, would have the ordinary effect of war upon treaties when not specially otherwise provided, and would remit both parties to their original and natural right of self-defence, *and give to the United States the clear right to close the canal against the other belligerent and to protect it and defend itself by whatever means might be necessary.*"

The foregoing considerations show the vital relation of the canal to the interests of the United States, and bring out the force of the remark of President Hayes, in his special message to Congress, dated March 8th, 1880, that the canal will be "virtually a part of the coast line of the United States."

As a matter of fact, it is far more vital than any particular portion of the coast line or any seaport, however important, because it is the key to the protection of many seaports and thousands of miles of coast line. It is far more vital to us than the Suez Canal is to Great Britain, because the Suez Canal affords communication not between the integral parts of the British Isles, but between those Isles and India, an alien nation, and a slightly shorter route to Australia, a colony, than is afforded by the route via the Cape of Good Hope. England possesses, moreover, numerous well defended bases and coaling stations on the route to southern Asia via the Cape of Good Hope, so that the closing to her of the Suez Canal would not interrupt her water communication either commercial or military even with India. The relation of the Panama Canal to the United States is far more analogous to the relation of the Kiel Canal to Germany; yet even here the analogy is not complete, for important as the Kiel Canal is to German commercial and military interests, its interruption or seizure by an enemy would lengthen the sea route for German war vessels by only a few hundred miles instead of by 8,000 miles

Assured control of so vital a possession is evidently an indispensable condition of our national security. In determining the measures which will be found most effective to accomplish this result, we naturally turn to a contemplation of the means and measures which have been employed almost invariably throughout the

(Concluded on page 399.)



Upper lock gates; Gatun Lake water in foreground.

The Gatun Dam and Locks

By Lieut.-Col. William L. Sibert, Corps of Engineers, U. S. A., Member Isthmian Canal Commission, Division Engineer Atlantic Division

Piers, west wing wall, which will break up wave action.

THE first authoritative recommendation for building a dam across the valley of the Chagres at Gatun was made in the minority report of the Board of International Engineers, convened by the President of the United States for the purpose of studying and making recommendations concerning the best type of canal across the Isthmus of Panama. This minority report recommended a lock canal with a lake 85 feet above the sea, formed by the Gatun dam.

The Chagres valley at this place is 7,920 feet wide, including a hill in the center in which existed suitable rock for founding a concrete dam for a spillway. Geologists state that the Gatun dam site was, at one time, 300 feet higher than now, and that during the period of this elevation the Chagres River cut gorges through the site toward the sea; one on either side of the Spillway Hill. After the subsidence referred to, the dam site was built up, evidently in an arm of the sea; portions of this sedimentary fill being of the finest clays. The low elevation of rock in these old gorges practically precluded any other type of dam than an earthen one. The supporting power of the material underlying the proposed earthen dam was not definitely known at the time of the submission of the minority report referred to above, and a section was recommended in this report, which presumed that there was a hard bottom underlying the lake face of this section.

An early study of the material available for hydraulic fill in the dam led to the belief that the slope on the lake face should be flattened in order that the hydraulic material might be stable when placed. This led to the first proposed change in the section of the dam, which was to construct a rock ridge at the toe of the lake side, of such height as would insure a slope of about one fifth from the top of this rock ridge to a reasonable height above the lake level. Work on other parts of the canal soon gave rise to the thought that another, and probably a controlling, element should enter into the design of this section; that element being the bearing capacity of the material underlying the dam. It was finally thought that the best and most economical section for the dam was probably one of uniform slope on both faces, thus making no violent change in the loading on any part of the foundation. The cross-section on the adjoining page approximates that condition, and is the section now tentatively adopted. The original height proposed for this dam was 135 feet above sea level. The approved height is 115 feet above sea level, while the tentative height to which the dam is now being built is to be not less than 105 feet above sea.

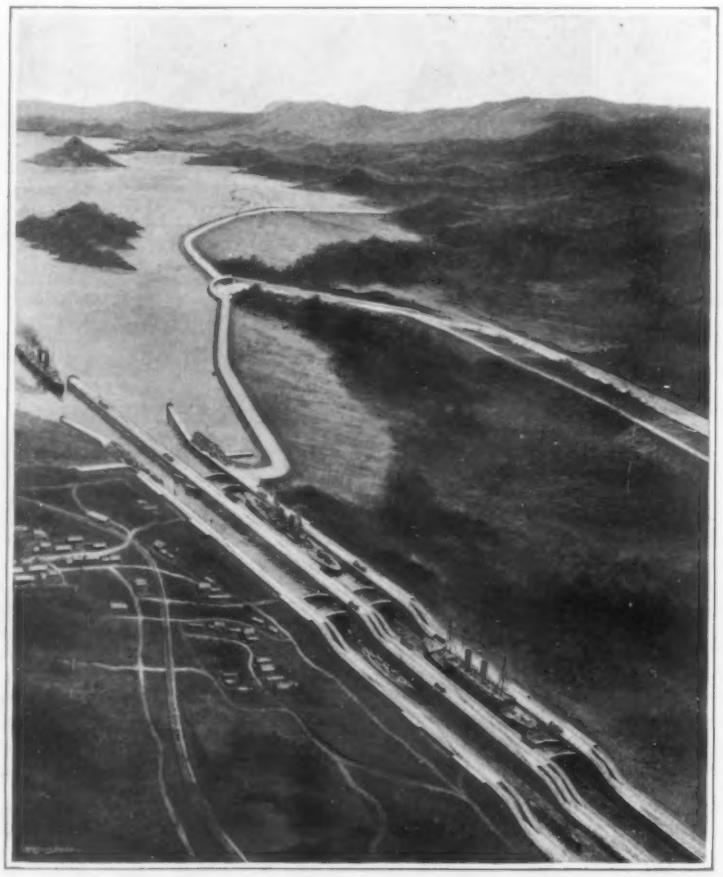
Construction.

The first operation in the building of the dam was to stop the flow of the Chagres River through its old channel next to the locks and through the old French canal, forcing the entire flow through a channel known as the "West Diversion," west of the Spillway Hill. (See general plan of the dam.) Trestles were then constructed on the 30-foot contour on both faces of the dam, and waste rock dumped by trains from such trestles, forming embankments between which the hydraulic material was pumped. (See photograph.) No trouble was encountered in closing these two channels; both they and the west diversion channel being at sea level. After the accomplishment of this, the excavation of a channel through Spillway Hill and the construction of that portion of the dam between Spillway Hill and the lock site, were commenced.

As the work progressed, and the dry fill commenced to overlap the underlying hydraulic fill, an effort was made to give such dry fill a face of about 15 feet above the wet fill. The thought was that this height of material, with loaded trains running over it, would compact the hydraulic fill and force to the center any very soft material, the softest of which would be taken out by the drain pipes. These drains (20-inch pipe), the function of which was to remove the surface water from the hydraulic fill "pond," were placed in such a way as not to endanger the stability of the dam. By varying the depth of the "pond" a greater or lesser amount of the finer clayey material could be removed.

One of the greatest construction difficulties has been the excessive amount of clay in the material available for the hydraulic fill. An excess of clay makes a water-tight fill, but such a fill drains itself very slowly, and, consequently, remains soft for a long time and increases the difficulty of making the overlying dry fill. An excess of clay also means that the slopes of the dam must be flat to insure stability in so far as the hydraulic fill itself is concerned. The east half of the dam, for a considerable portion of its length, has been practically completed for some months with every indication of perfect stability. A slow consolidation of the great mass of material forming the dam is going on and will probably continue for some time to come. The lake stands now at about 50 feet above sea level.

The permanent spillway channel, with concrete bottom and side walls, founded on rock, together with such preliminary work as could be done on the foundations of the spillway dam proper, was completed on April 24th, 1910, and the work of diverting the Chagres River from the west diversion channel to the spillway commenced. The elevation of the spillway channel is 10 feet above sea level, consequently in any attempt to stop the flow of the Chagres and force it through this channel, a rise of about 14 feet of water had to be encountered. The banks and bottom of the west diversion were soft clay. The plan adopted was to drive trestles across this channel on the 30-foot contour on each face of the dam, and to build, by dumping rock directly into the stream, two dams at the same time, hoping to distribute on such dams the head formed during construction. An unlimited amount of waste rock was available for this work. The banks of the channels were first made secure by dumping rock at the end of the trestles. After the channel was contracted to some extent, a considerable current developed; rock dumped from the trestles was carried some distance down stream, forming a rock apron in the bed of the stream below the dam. Quite deep holes, however, were dug by the water below this rock apron. When the work on the two dams had progressed so that a channel about 80 feet wide and 6 feet deep was left in the center, it was found impracticable to make any headway. Stone dumped from the trestles would be rolled down stream. The rainy season was then about to commence. The lower part of the bents of the trestles being well supported with rock, it was then decided to dump a carload or two of crooked rails above the trestles in such a way that they would form an entanglement and stop the rock, thus insuring either the construction of the dam or the taking out of the trestle. By this means the two dams were finally completed and the Chagres River successfully diverted.



Bird's eye view of Gatun locks, dam, and spillway, showing ships being towed through locks by electric locomotives.

Before turning the water through the spillway channel, stubs of piers, 20 feet apart, were built of such height that their tops would be exposed in the dry season. When the work of constructing the masonry dam in the spillway was commenced, these piers were immediately run up to an elevation of 45 feet above sea level and tracks for locomotives, cranes and trains laid on a bridge resting on these piers. Grooves were made near the lake end of these piers into which weighted timber curtains could be lowered by crane, so as to stop the flow of the river. This arrangement gave complete control of the Chagres and allowed the construction force to shut off any portion of it at any time they saw fit. Concrete was dumped between the piers directly from cars, and the lower part of the ogee was formed by dumping it into hoppers and conveying it to place through chutes. The masonry at each end of this dam is now to its full height excepting the piers between which the Stoney gates for controlling the lake level will be placed. The central portion of the dam, about 400 feet long, has been built up to elevation plus 50, over which elevation the water will be allowed to run during the coming rainy season.

For controlling the water, partially through the rainy season and entirely during the dry season, during construction, three openings 8 by 18 feet were temporarily left through the heavy masonry part of the dam, and Stoney gates of the same size as those used in the large culverts of the locks placed in these openings. Opening these valves next dry season will soon lower the lake level below the completed concrete and permit

the completion of the work. A cylindrical valve, of the type used in the locks, was also placed in this dam for experimental purposes.

Gatun Locks.

Raising ships to the lake level portion of the canal, which is 85 feet above sea level, is accomplished by a duplicate flight of three locks. Each lock has a lift of 28 1/3 feet, and will pass ships 1,000 feet long, of 40 feet draught and approximately 110 feet wide.

The locks proper are founded on rock and the heavy masonry is completed. This rock foundation was not of sufficient extent, however, at available elevations, for supporting the guide walls. Under that guide wall extending into the lake (see photo. on front page) the underlying rock at the south end is about 150 feet below sea level, and the overlying material is soft. This wall is cellular in construction. It is composed of four longitudinal walls about 2 feet thick with cross walls about 17 feet apart, all built of reinforced concrete.

The natural ground underlying the wall was about 8 feet above sea level. On this ground a wide fill with a very flat slope was constructed to elevation plus 35 dredges. These dredges cut their way into the space where the walls in question are to be built, making a channel just wide and deep enough for their passage. They then widened out the cut and deepened it to 41 feet below sea level. An earthen dam was then built across the narrow entrance cut, shutting off the connection with the sea, and as the dredges worked they were lowered. They are now floating at an elevation of 32 feet below sea level and can remove the material to the depth required. After the excavation is completed it is proposed to have the dredges excavate a sump 65 feet below sea level and lower the water to 50 feet below sea in order to test the stability of the sides of the cut. If there is no sliding the pit will be filled with water; the dredges floated out; the dam across the entrance channel replaced and the excavation unwatered for the construction of the walls first referred to.

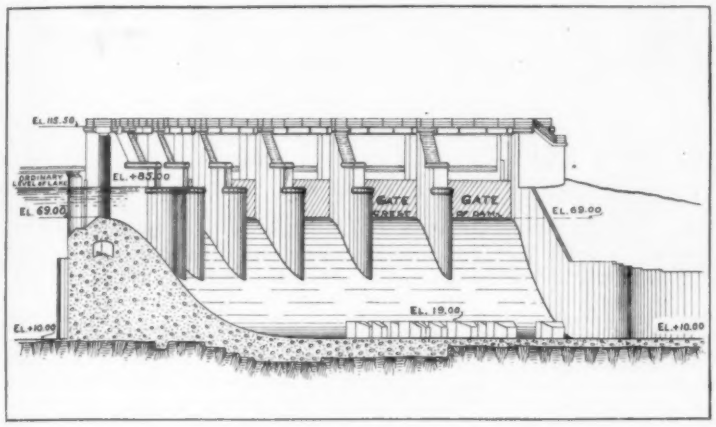
In the explorations made by diamond drills to determine the character of the foundations for the locks proper, the entire space was thoroughly covered by holes. After the character of the rock was determined, experiments were made to find out whether or not the underlying material was creviced so as to allow the passage of any material amount of water. These experiments showed that the crevices in the rock were very small, but that there might be sufficient passageway to transmit pressure under the lock floors. This resulted in constructing a floor in the upper lock, between the emergency dam sill and the intermediate gate that would resist full lake pressure, if received. Behind the remaining lengths of lock walls, drains of large stone were provided, and the corresponding floors made thin.

The operation of these locks differs from that of the ordinary lock. First: In that ships will not be allowed to enter and leave the locks under their own steam. They will be required to land along the side of the guide walls and will be taken in tow by four electric traction cars (see bird's eye view of locks and dam) and thus taken through the flight of locks. These cars, while under load, will be operated on a rack track; returning light, they will run on an ordinary track except when making the descent from one lock level to another. Second: Duplicate operating gates are provided at each end of the locks that connect with the lake level. These gates will be operated simultaneously so that if one gate is broken or damaged there will be a good pair of gates in position, and in addition, there is placed above each set of gates in the upper lock and below the sea gates of the lower lock, fender chains. These chains will be kept in such position as to bar the passage of a boat into the lock until it is ready for the boat to enter. Then the chain will be dropped into a slot in the floor.

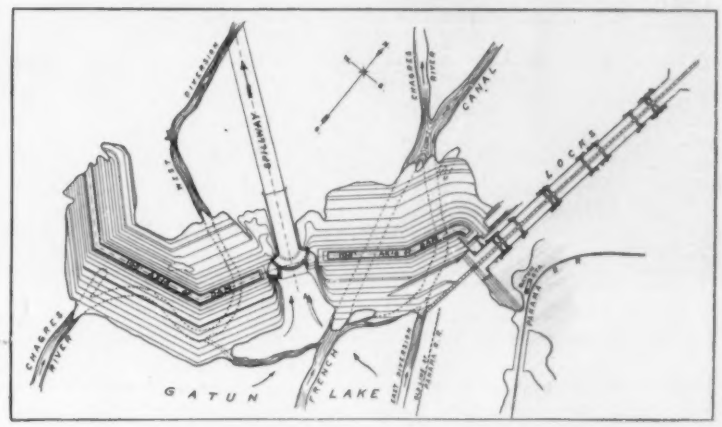
A swing-bridge emergency dam is provided for stopping the flow of water through the locks in case all of the gates in the upper lock should be opened or broken, so as to allow the passage of water.

Construction.

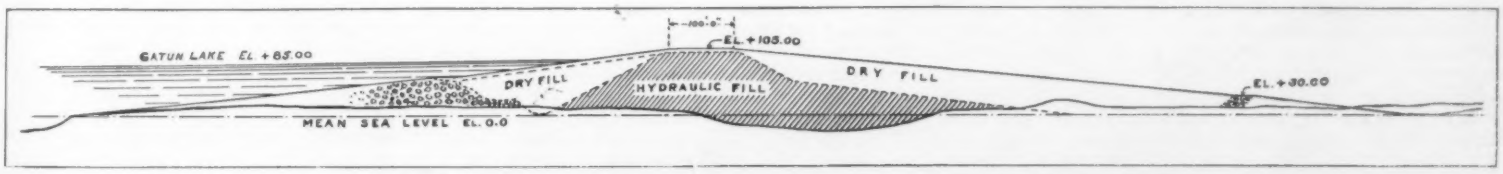
The masonry of the Gatun locks was largely placed by cableways, having a span of 800 feet, covering the entire space to be occupied by the locks. The stone and sand for the concrete were obtained, respectively, 20 and 40 miles down the Caribbean coast, and were brought in barges up the old French Canal as closely as possible to the lock site, and were unloaded by cableways into large stock piles near the bank. The material, however, was still 3,500 feet away and 60 feet below the center of lock construction. This situation caused the adoption of a central mixing plant near the central portion of the locks, consisting of eight 2-yard mixers. An automatic, electric, loop-line railroad, each car carrying the material for a batch of concrete, was installed, passing under the cement shed; under the sand and stone piles; and over the mixers. The mixed concrete was delivered to the cableways requiring it by an electric line, the flat cars of which were handled by electric locomotives. Steel forms (see front page engraving) were used in constructing the walls of the locks.



Section through center of Gatun dam spillway.



General plan of Gatun dam, locks and spillway.



Transverse section through Gatun dam, showing the final plan upon which it is being built.

Upper locks at Gatun, looking south toward the lake, showing gates completed to full height.

Gatun dam consists of a core of hydraulically-deposited, impervious silt between two rock fills.

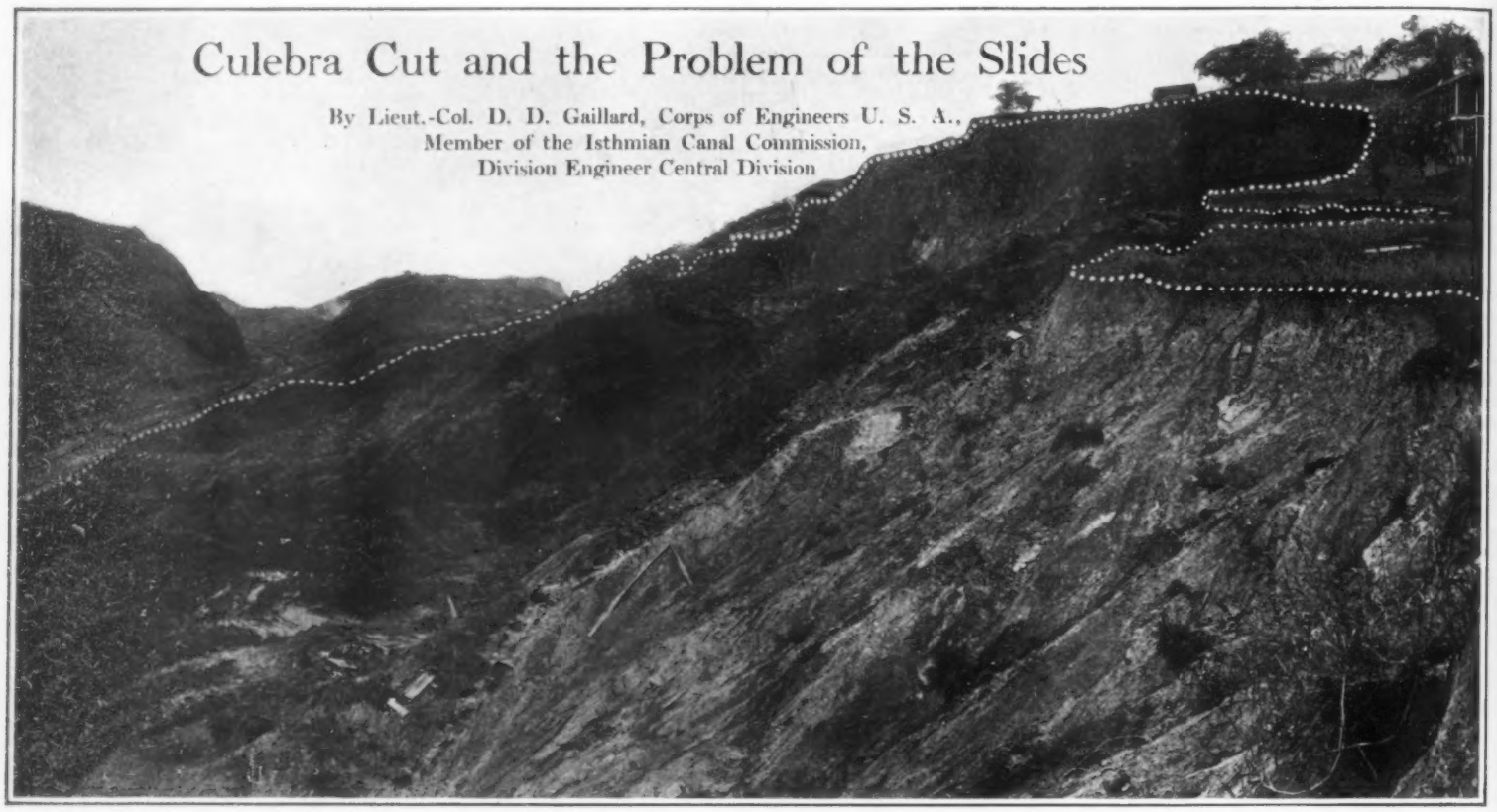
and through this piles about 60 feet long, 4-foot centers, were driven and a heavy reinforced concrete slab built around the heads of the piles, on which was erected the cellular structure. There was a continual slow settlement of this wall as its construction progressed. It was brought to a height of 61 feet above sea level through its entire length in order that the settlement might extend over the whole base before any part was brought to full height. At one time it showed an inclination to settle toward the east. This was corrected by pumping water into the west line of pockets and so maneuvering the water load as to make the wall settle vertically. This wall is now full height and stable, and the lake is rising around it, which will add to its stability.

The north guide and flare walls are yet to be built. It will be necessary to go to a depth of about 70 feet below sea level through very soft material in order to uncover the rock on which to build the flare walls. Under the guide wall itself the rock is at a still lower elevation, and a pile foundation will probably be constructed, the piling going to rock. The material in this space was too soft to hold up steam shovels, and it was decided to do the general excavation by suction

Belgian Taxicabs Must be Mud-proof.—Following the campaign of several of the automobile clubs of France and Belgium against the carelessness of drivers who bespatter pedestrians with mud and slush on rainy days, the city authorities of Anvers have issued an order compelling each taxicab to be fitted with a mud-shield, protecting the passer-by from mud thrown aside by the wheels. The style and shape of the protector is not definitely stated, it being left to the individual taste of the owner of the cab. All that the city fathers ask is that it be effective, elastically supported and of pliable material.

Culebra Cut and the Problem of the Slides

By Lieut.-Col. D. D. Gaillard, Corps of Engineers U. S. A.,
Member of the Isthmian Canal Commission,
Division Engineer Central Division



Slide on west bank of the cut, Culebra, September 27th, 1912, looking south toward Gold Hill. This slide occurred about August 25th, 1912, and involves about one and a quarter million cubic yards of moving material. It is composed wholly of clay and occurs where a natural pocket of this material existed.

THE Central Division, of which the writer has been in charge since April, 1907, extends from Gatun dam to Pedro Miguel locks, a distance of 31.7 miles, and embraces the entire summit level of the canal, the water surface of which is 85 feet above sea level.

For administrative purposes, the Central Division was divided into two parts, known as the Chagres section and the Culebra section—the latter being generally known as the Culebra cut. This section extends from the Chagres River at Gamboa to the Pedro Miguel locks, a total distance measured along the axis of the canal of 8.8 miles, and comprises the natural summit of the water shed which separates the Pacific Slope from the Caribbean Slope, and culminates in Gold Hill on the east bank of the canal and Contractor's Hill on the west bank. As a consequence, this comparatively short section embraces nearly one half of the total excavation required for the entire waterway between the Pacific Ocean and the Caribbean Sea.

Actual excavation on this section was commenced by the French in January, 1882. The plan under which the greater part of their work was carried out was for a sea level canal, 72.16 feet in width at the bottom and 27.9 feet in depth. Owing to financial and physical difficulties, this project was modified in 1887 to a lock canal with ten locks and with a summit level 160.7 feet above sea level, and, with the exception of the period between May, 1889 and October, 1894, work was carried on continuously in the Culebra cut, first by the "Old French Company" until it failed in 1889, and later by the "New French Company," with greatly diminished forces, until the United States assumed control in May, 1904.

From the commencement of operations by the French until the canal was acquired by the United States, a total of 24,588,520 cubic yards of material was excavated within the limits of the Culebra cut, of which 20,419,720 cubic yards form a part of the present approved project.

This project in the cut is for a canal with a minimum width of 300 feet on the bottom, a minimum depth of 45 feet and a width on the water surface of 309 feet. To secure these dimensions in the Culebra cut, it is now estimated that it will be necessary to excavate in all about 115,000,000 cubic yards of material, including the useful French excavation, of which about three quarters is classified as rock.

When the United States acquired control of the canal in 1904, the entire force of laborers who had been working under the French Company, about six or seven hundred in number, were transferred to the United States' pay-rolls, thus preventing any actual cessation in the work of constructing the canal. This original force was increased from time to time until it attained its maximum in March, 1911, during which month the average daily working force in the Culebra cut, and on the dumps connected with it, was about 900 Americans and 7,300 European and West Indian laborers.

The engineering problems connected with the work are handled by the engineering force, under a resident engineer. In addition, there is a superintendent of transportation, who handles all transportation matters in the Central Division, and a superintendent of the water and air service, who sees that all shovels, drills, pumps, etc., are connected with water and air mains. That these positions are no sinecures may be inferred from the fact that in the one case over 1,000 loaded and empty trains have been handled in the Central Division in a nine-hour day, and in the other, an average of two miles of water and air pipe is laid and two miles taken up, for every working day in the year.

As most of the material to be excavated consists of rock varying from very soft rock, which readily disintegrates on exposure to the atmosphere, to very dense rock of great hardness, it is necessary before this material can be excavated, that it be drilled and blasted. Two kinds of drills are used in this work—tripod drills and well drills, and both obtain their power from a 10-inch compressed air main on the west bank of the cut, running parallel with the same. This main is supplied by three batteries of air compressors located at equal distances along the ten miles of main. All excavation in the cut is done with steam shovels with 3-yard and 5-yard dippers, the latter being used almost entirely. The order of operation is as follows: Drill holes are placed normally about 14 feet apart and staggered. Their usual depth is about 27 feet, being three feet deeper than the depth to which the shovel excavation is to extend. When these holes have been completed, they are loaded with 45 per cent potassium nitrate dynamite, in suitable quantities, depending upon the character of the rock. A group of holes are connected "in parallel" and fired by means of a current from the electric lighting plant. The shovel then follows at a suitable distance and loads the material onto steel cars, which are dumped by hand, or on Lidgerwood trains, from which it is plowed off at the dumps by means of unloaders, and plows weighing from 14 to 16 tons.

The maximum number of drills in use at any time in the Culebra cut was 377, of which 221 were tripod drills and 156 were well drills. With these drills, an aggregate of over 90 miles of holes have been drilled in a single month. In blasting operations, a pound of dynamite is now used to about every 2¼ cubic yards of material blasted, and the quantity of dynamite used per annum in the Culebra cut for several years past has averaged about 6,000,000 pounds. The greatest number of shovels in use at one time in the cut was 43, and the greatest monthly excavation in any single month was obtained in March, 1911, when 1,728,748 cubic yards of material, mostly rock, were excavated.

To handle this amount of material required the services of 115 locomotives and 2,000 cars, giving about 160 loaded trains per day to the dumps, which on the average were

View showing point of deepest excavation in Culebra cut, September 30th, 1912. Gold Hill on the right, where highest point of excavation will be 494 feet above the bottom. Contractors' Hill on the left, where highest point of excavation will be 364 feet above the bottom. The water standing in the lowest level is 6 feet above the bottom.

about 12 miles distant, the haul one way varying, however, from about one mile to 33 miles. To serve properly the trains and shovels employed in excavation work in the cut, although the latter is less than nine miles in length, about 100 miles of track are required, or an average of over nine parallel tracks at all points of the cut.

The deepest excavation is at Gold Hill, where the highest point of excavation is 494 feet above the bottom of the canal. At Contractor's Hill, a cut 364 feet in depth will be made in the face of the rock hill. The widest part of the cut is opposite the town of Culebra, where owing to the action of slides on both banks, the top width is now about half a mile.

In the earlier stages of the work, accidents resulting from the use of dynamite were unfortunately not uncommon, and one of the first steps taken was to require a strict inspection of the handling of dynamite and the loading and firing of holes. In spite of every precaution, it was found impossible to avoid a considerable number of miss-fires, and a study was made, with the assistance of the electrical and mechanical engineer, with a view of endeavoring to locate definitely the cause of these miss-fires.

As a result of a long series of experiments, it was conclusively shown that by far the greater number of miss-fires were due to the fact that the holes had been wired "in series." When the fuses were connected "in parallel" and fired by means of the ordinary electric light current, not a single failure of a fuse was noted in a test comprising several hundred fuses.

The results of this investigation were so convincing that all holes are now wired "in parallel" and miss-fires have been almost wholly eliminated, although it is scarcely necessary to state that accidents from individual carelessness, from flying stones, or from other causes, will always occur in the extensive use of dynamite, no matter what precautions may be adopted. It is, however, gratifying to state that although during the past three and one quarter years, in work under the writer's charge over 20,000,000 pounds of dynamite were used in blasting, but eight men have been killed, three of whom failed to go to a safe distance and were killed by flying stones, and two by miscounting the number of shots which had gone off in a "dobe" group, and approaching the group before the last shot had exploded.

Then, too, the character of the material to be blasted is of such a nature that slides and slips are of constant occurrence, rendering the use of explosives more hazardous than in ordinary localities. In addition, ever since the work of excavation has been commenced in the Culebra cut, areas have been uncovered where, owing to the presence of iron pyrites in finely divided form, the material on exposure to air generates, by oxidation, a sufficient degree of heat to fire dynamite when placed in the drill holes, and on two occasions dynamite has been so fired, but fortunately, without loss of life. As the heated layers may lie at any distance below the surface of the ground, and are usually rather limited in thickness, it is impossible from external observation to detect the heated holes by inspection, and in cases where danger from heating is apprehended, an iron pipe ¾ inch in diameter is dropped into the hole and allowed to stay there about ten minutes. On being taken out and passed rapidly through the hand, it can readily and accurately be determined whether or not there is a heated layer of material in the hole, and if so, where it is located. On one occasion, a mass of heated material was encountered, which it was necessary to blast and remove with as little delay as practicable, and this was safely done by playing a stream of water from a hose into the holes during the entire process of loading and until the holes were fired.

The total amount of material excavated from the Culebra cut to date is as follows: By the French, prior to May, 1904, 20,419,720 cubic yards. By the United States, May, 1904, to October 1st, 1912, 85,370,236 cubic yards. Amount remaining to be excavated, October 1st, 1912, 9,250,000 cubic yards.

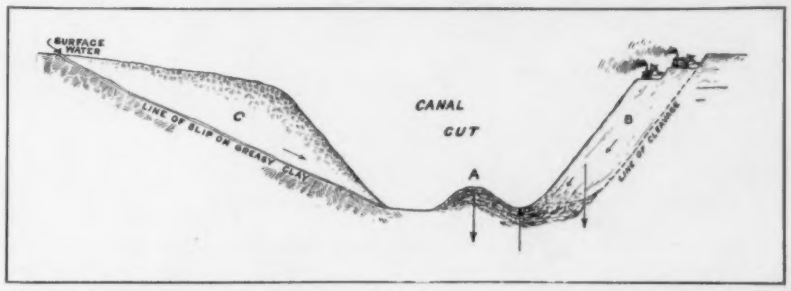
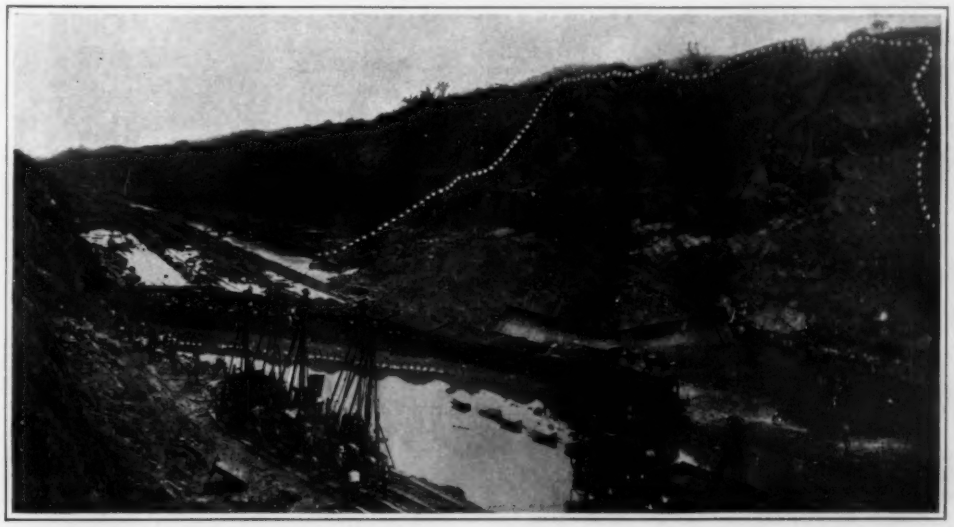
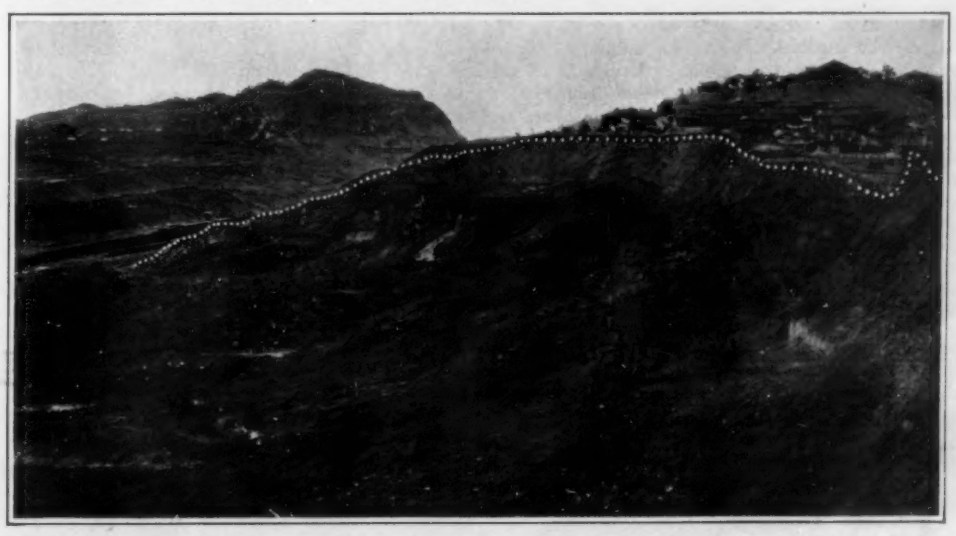


Diagram showing the action of slides in the Culebra cut. The mass C is moving into the cut by sliding; the mass B breaks on a line of cleavage and crushes the underlying material, forcing it up at A as shown. Note steam shovels taking off top weight from B.

Parallel with the Culebra cut and on each side of it diversion ditches or canals were constructed in order to keep the waters from the drainage areas on the two sides of the cut from flowing into the latter and interfering seriously with or preventing excavation during the rainy season. The diversion ditch on the west side of the canal is known as the Camacho diversion, and is about 5½ miles in length, extending from Culebra to the Chagres River. This diversion has a capacity, at its mouth, of 3,000 cubic feet per second and was constructed by the French. On the east side of the cut, between Gold Hill and the Chagres River, for a distance of 5¼ miles, extends the Obispo diversion, which drains an area of nearly 10 square miles, having an average annual rainfall of about 83 inches, most of which occurs in eight months of the year. Its construction has cost up to date about $1,250,000—a large sum, yet without its protection, the canal could not have been completed. This diversion has been constructed since the United States assumed control. The third diversion, known as the Rio Grande diversion, extends from Rio Grande to Pedro Miguel, a distance of about three miles, and was constructed by the French. The large and annoying Cucaracha slide on the east side of the canal, between Gold Hill and Pedro Miguel, prevented the construction of a diversion along that portion of the Culebra cut.



Slide in rock bank, side of cut north of Empire, which occurred August 20th, 1912. About 400,000 cubic yards of rocks slipped into the cut, destroying tracks, wrecking cars, and permitting the waters of the Obispo Diversion to flow into the cut.



Slide at Culebra on the dump, west bank of canal, north of Culebra. About 1,000,000 cubic yards of material in motion moving toward the cut at the rate of three feet per day on a bottom slope of about one vertical to seven horizontal. June, 1912.

The Problem of the Slides.

During the early stages of the work by the United States, there was but little movement of material into the canal from outside of the prism, and when such movement began, it was due almost entirely to slides caused by the slipping of the top layer of clay or earth upon a smooth sloping surface of some harder material, the layer of slipping clay in such cases varying in thickness from 10 to 40 feet.

The largest slide of this character is the Cucaracha slide on the east bank of the canal, just south of Gold Hill, which embraces a total area of over forty-seven acres. This slide extends up the bank for a distance of over 1,900 feet from the axis of the canal, and originally had a slope of about one vertical to seven horizontal. It first began to give serious trouble in the fall of 1907, and moved completely across the canal, the toe of the slide advancing for the first ten days at a uniform rate of about 14 feet in twenty-four hours. All tracks in its path were covered or destroyed by its resistless motion, and the moving material actually rose up on the west bank to a height of about 30 feet. Its movement was singularly like that of a glacier. It was, in fact, a tropical glacier—of mud instead of ice—and stakes aligned on its moving surface and checked every 24 hours by triangulation, showed a movement in every respect similar to stakes on moving glaciers in Alaska upon which the writer had made observations in 1896. Up to July 1st, 1912, nearly 3,000,000 cubic yards had been removed from this slide, and it was estimated that about 230,000 cubic yards yet remained to be removed.

As the depth of the cut increased and the lateral support formerly afforded by the excavated material was removed, the great pressure of the superincumbent banks caused the crushing and squeezing out of under-lying layers of soft material, with a breaking, shearing and settling of the high banks and a corresponding elevation or "humping" of the bottom. (See diagram showing action of slides.) For the past two or three years, slides or breaks of this character have greatly exceeded those of the type represented by the Cucaracha slide. The largest slide of the type just described is on the west bank of the canal at Culebra, and covers an area of 75 acres. Up to October 1st, 1912, over 7,500,000 cubic yards of material had been removed from this slide and fully 2,000,000 cubic yards remained still to be removed. The

only remedy for slides of the first class has been to dig and haul away all of the material involved in the slide. With slides or breaks of the second class, a like course is pursued for banks already broken; but with slides of the latter class, preventive measures as well are taken. These preventive measures consist in flattening the slope of the bank where breaks might be expected by excavating and removing the upper portion of the banks by steam shovels, thus decreasing the pressure which might otherwise crush underlying layers of softer material and cause the bottom to heave up. This lightening of the superincumbent weight of the adjacent banks in the deeper portions of the cut by flattening the slope, has given results sufficiently encouraging to warrant the continuance of this work until all excavation has been completed and the full depth and width have been obtained.

With a few exceptions, the so-called slides during the past year were in reality breaks in the bank, resulting from the crushing of an underlying layer due to the great pressure of the high banks, the underlying layer being displaced laterally, and causing a heaving up of the bottom, amounting in one instance to as much as 30 feet.

On one occasion the writer was standing on a portion of the bottom of the cut, which rose six feet in about five minutes, and moved so smoothly and with so little jar as to make the movement scarcely appreciable, it being his impression at first that the steam shovel which he was observing was sinking and not that he was rising.

Innumerable plans for treating the slides have been suggested by interested and patriotic citizens throughout the country, but not one of them has proven practicable. The only successful method of treating the slides or breaks, once the material is in motion, is to dig it out and haul it away until the slide comes to rest upon reaching the angle of repose for the particular material then in motion. This angle of repose varies much in different localities, depending upon the character of the material composing the slide, the angle of inclination of the strata and the angles of the numerous dikes, faults, seams, etc. At the Cucaracha slide, which has been practically at rest now for about a year and a half, the angle of repose corresponds to a slope a little steeper than one vertical to five horizontal, while on the west bank of the cut at the town of Culebra, the material is still moving slightly on a slope of about one vertical to five horizontal.

In one or two slides which have developed in the cut, the surface on which the material was sliding, had a slope of one vertical to ten horizontal, and in the case of another slide on the west bank of the canal, north of the village of Culebra, the moving material, which consisted of stratified rock, was moving *en masse*, at the rate of three feet in 24 hours, on a lignite layer about six inches thick, which had a slope of about one vertical to seven horizontal and was underlaid by layers of sedimentary rock, which did not move. A rather remarkable thing about this last slide was that, like two or three other slides, it developed in the dry season and moved at a faster rate during the four months when there was no rain than it has done since the rains have come.

The writer is aware that there is a very general impression that slides are due solely to saturation by rainfall, or underground water, of the material which is in motion, and while this is to a great extent correct for the slides like the one described at Cucaracha, yet there have been three large slides, involving in all nearly 2,000,000 cubic yards of material, which developed during the dry season and were composed wholly of material so dry that when loaded on the trains, the cars were almost hidden during the windy season by clouds of dust. One of these slides was moving on a surface which had a slope of one vertical to six horizontal, and its rate of advance was about 2½ feet per day for several months. A steam shovel made 103 cuts across the toe of this slide with the position of the loading track unchanged.

From the commencement of operations up to October 1st, 1912, there had been excavated and removed, about 18,000,000 cubic yards of material from slides, aggregating an area of about 220 acres, and there probably remain yet to be excavated on account of slides at least three or four million cubic yards more.

As the result of several years experience, slides and breaks are now handled with less inconvenience and interruption to other work than was the case in the earlier stages of operations. Yet, notwithstanding increased efficiency in handling them, they cause continual annoyance and interruption to work, and decrease the output and complicate the engineering problems; and while they present no insurmountable obstacles to the completion of the work in the Culebra cut, yet they are ever-present sources of annoyance, hindrance and expense. Their effects are especially felt in the destruction, displacement or covering up of tracks, requiring large track gangs to be kept continually at work in their vicinity.

A conservative estimate indicates that within the 8.8 miles of the Culebra cut, fully 200 miles of track have been destroyed, covered up or have had to be built, solely on account of slides; and in one locality for nearly two years tracks have had to be maintained on material moving at a rate varying from one or two inches to several feet per day, necessitating the constant presence of a track gang in order to permit the uninterrupted passage of trains.

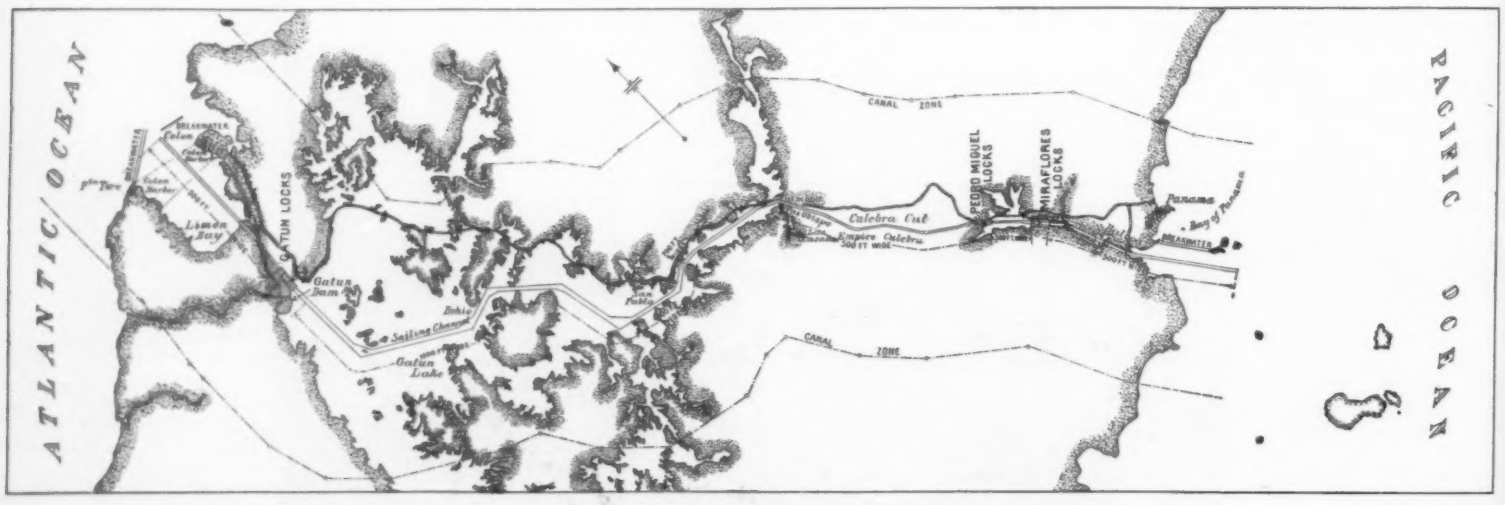
It will be seen from what precedes that when the Culebra cut shall have been completed, not less than 22 per cent of all material excavated by the United States will have been removed on account of slides, and that they will have added twenty-one or twenty-two million cubic yards to the amount of material to be excavated.

On the other hand, while their existence has increased the difficulties of the work and has added very considerably to the amount of excavation, and consequently to the cost, yet they have so far presented no obstacles which cannot be overcome without delaying the predicted date for the opening of the canal; nor will the additional material excavated on account of slides require any further appropriation in excess of the estimate submitted by the chairman and chief engineer on September 1st, 1908.

In this estimate, the "Division Cost" of all dry excavation remaining to be done in the Central Division after September 1st, 1908, was given as 75 cents per cubic yard, whereas the total cost of all excavation in the Central Division from September 1st, 1908, to September 1, 1912, was but $0.5134. The difference between the unit price submitted in the estimate and that at which the excavation was actually done between September 1st, 1908, and September 1st, 1912, amounts to a total of $17,013,645, the amount of excavation in question, having been 71,908,898 cubic yards—about three fourths being rock.

It must not be understood, however, that this total of over seventeen million dollars will be a clear saving, as fully seventeen to eighteen million cubic yards in addition to the estimate of September 1st, 1908, will have been added by the slides before work in the Central Division has been completed; and besides, a considerable amount of work not then contemplated has since been done. Yet, in spite of these large additions, aggregating probably nineteen or twenty million cubic yards to the quantity of material as submitted in the original estimate, it seems probable that there will still remain from the estimate of September 1st, 1908, an ample surplus of funds for completing the work in the Central Division without additional appropriation.

So far as the time of completion of excavation in the Culebra cut is concerned, in spite of the large additions by slides, the work is still well up to the original schedule, and had there been no slides, would have been completed with ease in January, 1912; an amount of material equivalent to the total excavation, exclusive of slides, having been removed by that time. In reality, however, it would have been completed sooner, as slides have decreased the average monthly output in addition to adding a large surplus of material.



Map of the Panama Canal.

The Greatest Engineering Work of All Time

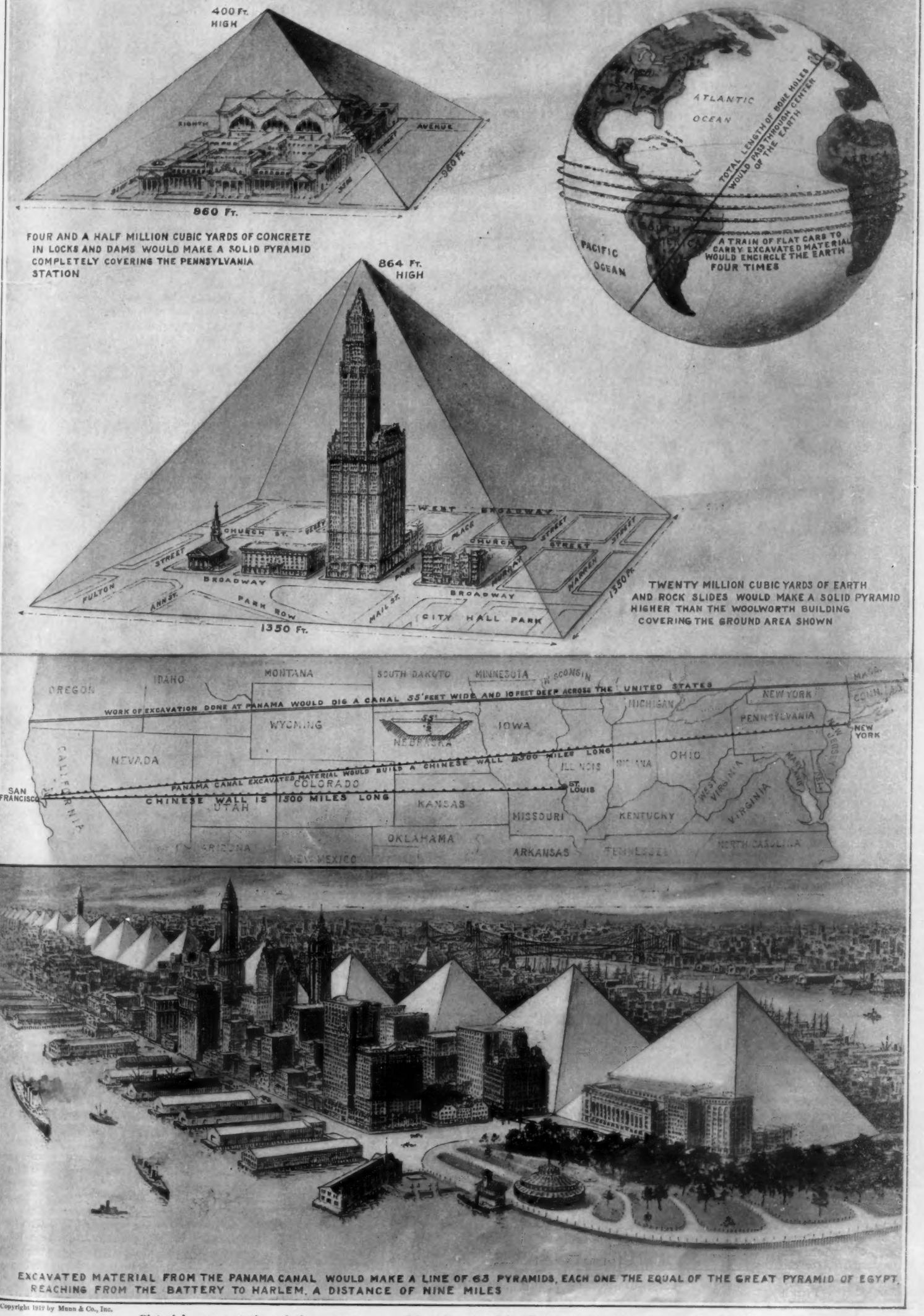
IN conveying ideas of size and quantity to the mind there is a point at which the use of figures—mere figures—becomes altogether inadequate. When statistics run into the millions, the mind, unless it is assisted by some more or less concrete scale of measurement, fails to form an adequate conception of what they mean. That this is particularly true of the great engineering work which is now drawing to a close on the Isthmus of Panama is proved at once by a glance at the pictorial representation on the adjoining page—a method of illustration with which our readers have been made familiar during the past few years in the columns of the SCIENTIFIC AMERICAN.

Alike in times ancient, medieval and modern, the great pyramid of Egypt (one of the "seven wonders" of the Ancient World) has been taken as the standard of measurement for engineering and architectural structures of exceptional proportions. Now, when the engineers of the canal tell us that the total amount of excavation taken out of the completed canal will reach the great total of 212,227,000 yards, the average citizen understands, of course, that this represents an enormous mass of material. But when he is told that if the excavated earth and rock were dumped along the line of Broadway, New York, it would prove sufficient to form no less than sixty-three great pyramids, reaching for a distance of nine miles from the Battery to Harlem, there is little danger of his failing to appreciate the magnitude of the task of excavation at Panama.

Everybody knows that much trouble has been given along the line of the canal by slides of great magnitude. When we read that the total amount of extra material additional to the original estimate of excavation, which must be painfully shoveled onto the cars and hauled away out of the Culebra cut amounts to over 20,000,000 cubic yards of earth and rock, we apprehend but do not comprehend what this means. But when we are told that this material, if built into one huge mass, would make a pyramid of solid material reaching along Broadway from Chambers Street to Fulton Street and extending from the City Hall in City Hall Park to West Broadway, and that the apex of this pyramid would tower one hundred feet above the top of the Woolworth Building, we comprehend what a vast amount of additional work has been imposed upon the engineers by the unstable and treacherous character of the volcanic material through which the canal is being dug.

Also we know that the concrete work which has been done in building the locks at Gatun, Miraflores and Pedro Miguel constitutes the biggest job of concreting ever undertaken. We understand, in a general way, that the four-and-a-half million cubic yards of concrete must represent a big bulk of materials. As a matter of fact, sufficient concrete has been put in the locks and dams of the canal to form a pyramid 900

(Concluded on page 405.)


400 Ft. HIGH
960 Ft.
960 Ft.
FOUR AND A HALF MILLION CUBIC YARDS OF CONCRETE IN LOCKS AND DAMS WOULD MAKE A SOLID PYRAMID COMPLETELY COVERING THE PENNSYLVANIA STATION
ATLANTIC OCEAN
PACIFIC OCEAN
TOTAL LENGTH OF BORE HOLES WOULD PASS THROUGH CENTER OF THE EARTH
A TRAIN OF FLAT CARS TO CARRY EXCAVATED MATERIAL WOULD ENCIRCLE THE EARTH FOUR TIMES
864 Ft. HIGH
1350 Ft.
1350 Ft.
TWENTY MILLION CUBIC YARDS OF EARTH AND ROCK SLIDES WOULD MAKE A SOLID PYRAMID HIGHER THAN THE WOOLWORTH BUILDING COVERING THE GROUND AREA SHOWN
WORK OF EXCAVATION DONE AT PANAMA WOULD DIG A CANAL 55 FEET WIDE AND 10 FEET DEEP ACROSS THE UNITED STATES
PANAMA CANAL EXCAVATED MATERIAL WOULD BUILD A CHINESE WALL 2000 MILES LONG
CHINESE WALL IS 1500 MILES LONG
SAN FRANCISCO
ST. LOUIS
NEW YORK
EXCAVATED MATERIAL FROM THE PANAMA CANAL WOULD MAKE A LINE OF 63 PYRAMIDS, EACH ONE THE EQUAL OF THE GREAT PYRAMID OF EGYPT, REACHING FROM THE BATTERY TO HARLEM, A DISTANCE OF NINE MILES

Copyright 1912 by Munn & Co., Inc.

Pictorial representation of the enormous quantities of material handled in constructing the Panama Canal.

Barrel screened to keep out yellow-fever-carrying mosquitoes.

The Sanitation of the Canal Zone

Teaching the Tropics How to Live

By Dr. A. J. Orenstein, of the Department of Sanitation, Panama Canal

Spraying with oil to kill the mosquito larva.

IN 1905 a young physician received an appointment in the medical service of the Canal Zone. He told the news to a professor in one of the leading colleges of the United States, a medical man of note, a man who has served with great credit and ability in a difficult post as head of the Health Department of one of our largest cities. This professor glanced at the letter of appointment and asked: "Are you going to accept the appointment?" "Yes, I am going next Monday." "You are a fool, are you so tired of life that you want to commite suicide?" And this gentleman's remarks were typical of what many well-informed men would have said, and with good reason, at that time. Let us glance at the sanitary history of Panama. For centuries the Isthmus of Panama was regarded as one of the worst plague spots of the world. The Spanish occupation in the sixteenth, seventeenth and eighteenth centuries was paid for with a fearful toll to death. The sturdy pioneer railroad builder, Aspinwall, carried forward to a successful conclusion the construction of the Panama Railroad, a railroad forty-eight miles long, at a cost of life impossible to verify but to which the popular, if fallacious, legend gives a clue: "A life for each tie of the forty-eight miles."

In January, 1881, with pomp and circumstance, with speech-making and champagne, with all the ceremonies so dear to the Gallic heart, the great French engineer, Ferdinand de Lesseps, fresh from his triumph in Suez, inaugurated the work of building the Panama Canal. De Lessep's little daughter turned the first spadeful of earth in the Panama Canal prism. Almost simultaneously with this first excavation, another and grimmer kind of excavation commenced—the digging of graves for the thousands who laid down their lives because the great engineer who fought so successfully the shifting, treacherous sands of Suez, and who could have, no doubt, conquered the many physical obstacles in Panama, did not recognize his most powerful antagonist in the humble little mosquito. And so, with the very first day of work on the canal, the harvest of death and disease commenced. Just how heavy it has been can only be surmised, for the mortality and morbidity statistics of the French were very incomplete. Says Froude: "In all the world, there is not, perhaps, now concentrated in any single spot, so much swindling and villainy, so much foul disease, such a dung-heap of moral and physical abomination as in the scene of this far-famed undertaking of the nineteenth century." And to this veritable Hades of disease and death, France sent her noblest and bravest sons, who, with Death grinning over their shoulders, did work that is a monument to their engineering skill, their ability and, above all, their courage. It took nerve to come to Panama then. It took an incredible amount of nerve to stay. Every Frenchman who came to Panama knew that he was going to have yellow fever, and that every second man taken with it would die. The family of a French chief engineer consisted of five; four died of yellow fever. Of the five members of the family of the superintendent of the railroad, three died of yellow fever. Of twenty-five Sisters of Charity who came to Ancon Hospital, twenty died of yellow fever. And so, when we speak of the squandering of money by the French, let us not forget that the "men on the job" squandered but one thing—their lives. France failed to build the canal, but she failed only because her chief enemy was unknown to her and, in her very failure, France presented to the world an example of personal heroism and of engineering skill that she may point to with great pride.

Colon—D Street, from Eleventh Street, looking north. December, 1908.

Colon—D Street, showing sewer and macadam road completed. July, 1911.

THE SANITATION OF THE ISTHMUS

When the United States Government undertook to build the Panama Canal, it was recognized that the Canal Zone must be made habitable if the canal were to be built. Accordingly, measures were undertaken to rid of yellow fever the two terminal cities—Colon on the Atlantic and Panama on the Pacific. Simultaneously a maritime quarantine service was established to prevent the entry into the Canal Zone of communicable diseases. The theory of the rôle of the mosquito in the transmission of yellow fever had been firmly established by the work in Cuba. The campaign against yellow fever was, therefore, inaugurated along the following lines: (1) Isolation of yellow fever patients during the infectious period of the disease in such a manner as to prevent their being bitten by mosquitoes. This was accomplished by removing all yellow fever patients to a screened room in the hospital. (2) Fumigation of the houses where yellow fever cases were found, and the houses adjacent to these. This for the purpose of destroying the yellow fever infected mosquitoes that might remain within the houses; for the mosquito transmitting yellow fever, the Stegomyia (or *Aëdes*) calopus, does not fly far, but rather remains near the place where it bred out and had its blood meal. (3) Protection of dwellings against mosquitoes by screening with wire gauze. (4) Destruction of all places favorable for the breeding of the Stegomyia calopus—the last task was a difficult one. The Stegomyia calopus is a house mosquito. It breeds in water vessels near human habitation: Cisterns, water pitchers, barrels, tin cans, etc. Neither Pana-

ma nor Colon had public water supplies, the people depending on rain water and on water sold by vendors. In each household there were a number of water containers wherein the Stegomyia bred in profusion. The first thing done was to reduce to a minimum these water containers. Such vessels as were absolutely necessary for the storage of water were screened with wire gauze. The providing of Panama and Colon with satisfactory water supplies was at once undertaken and pushed forward as rapidly as possible. With the introduction of modern water supplies the collection of water in cisterns, barrels, etc., could be discontinued and thus, the breeding places of the Stegomyia were practically entirely destroyed. From having been the most numerous species of mosquitoes in Panama and Colon in 1905, the Stegomyia has now become the species least frequently encountered. A Stegomyia mosquito is now very hard to find, indeed. The results of this work were very soon manifested, as the following figures will show: From July 1st, 1904, to June 1st, 1905, 77 cases of yellow fever originated on the Isthmus. In June, 1905, 62 cases; in July, 42; in August, 27; in September, 6; in October, 3; in November, 2; December (in Colon), 1. During 1906 there was only one case of yellow fever on the Isthmus, in Colon. Since then not a single case of yellow fever occurred on the Isthmus, although a continuous influx of non-immunes is taking place.

With yellow fever under control, attention could be directed to the second enemy of the white man in the tropics—malaria, this disease is transmitted by certain members of the mosquito genus Anophelinæ. These mosquitoes differ greatly from the Stegomyia calopus in their breeding habits. While the Stegomyia calopus breed in water containers close to human habitations and do not fly very far, the Anophelinæ breed in streams, marshes, water holes, etc., and are capable of traveling considerable distances, probably as far as a mile and a half.

Pedro Miguel, showing mess hall and family quarters, screened against mosquitoes. 1911.

Toro Point, showing labor quarters with self-closing garbage cans. July, 1911.

The campaign against malaria was inaugurated on the following plan: (1) Treatment with adequate doses of quinine (about 30 grains a day for adults) of all cases of malaria. First, because this treatment is curative; and, second, because, unless so treated, each case of malaria constitutes a focus from which malaria spreads. In malarial regions there are many persons who have what is often spoken of as chronic malaria. Such individuals frequently do not suffer any serious inconvenience. They more often suffer from occasional headaches, anemia or slight fever. These are the people most dangerous from the standpoint of the sanitarium. It is in the blood of these individuals that the malaria causing parasite has attained the form in which, if taken by a female Anopheline, it developes within this mosquito into the form capable of causing malaria in the individual whom the Anopheline may bite a week or so thereafter. (2) Protecting dwelling with copper wire gauze against the ingress of mosquitoes. All the houses occupied by Americans, and most of the others are screened. (3) Catching and killing mosquitoes within the dwellings. This is done by negro "mosquito-catchers," and is of great value in preventing malaria where other prophylactic measures cannot be inaugurated. (4) Destroying the breeding places of Anophelinæ by filling, draining, and training the banks of streams. (5) Destroying the Anophelinæ in the larval and pupal stages by oiling the water in which they are found, or applying a special larva poison to this water. (6) Clearing the rank vegetation in the immediate vicinity of dwellings and settlements, so as to destroy the shelter for such mosquitoes as may find their way to the vicinity of the houses; to hasten evaporation and the drying of small water collections and marshy places; to expose to view small breeding places and to remove the temptation to throw water containers into the vegetation.

These measures, conscientiously and painstakingly carried out, resulted in reducing the number of malaria cases treated in the hospitals from 6.83 per cent of the working force per month in 1906 to 1.53 per cent of the working force per month in 1911, and the death from malaria among employees from 233 in 1906 to 47 in 1911. In 1906 a good deal of preventive work had already been accomplished. What malaria would have done to the working force, had conditions remained as they were in 1904, is indicated by the fact that among 150 U. S. Marines stationed at Empire in the Canal Zone in 1904, 170 cases of malaria developed in four months.

In addition to the measures having an immediate relation to the prevention of disease, the steps taken to provide the employees at work on the Canal with comfortable quarters and wholesome food and recreation, have undoubtedly contributed greatly to the maintenance of good health. The history of pneumonia among the negroes illustrates this point. In 1906, before provision had been made to feed the laborers, and when housing had not been brought up to the present standard, a number of cases of pneumonia occurred among the negro laborers. The mortality from pneumonia was 413 in 1906 and 328 in 1907. A board appointed to study this disease recommended that the laborers be fed by the Government and that certain improvements in their housing be made. When these recommendations were carried into effect the number of cases of pneumonia immediately diminished. In 1908 there were but 93 deaths; in 1909, 70; in 1910, 73; in 1911, 94.

To carry out the preventive measures against malaria and yellow fever, the two principal enemies of the Caucasian in the tropics, as well as all the other sanitary work and treatment of the sick in the various hospitals, camps and in the homes, a force of about 1,400 is employed, of which about 750 are employed in the two terminal hospitals of Ancon and Colon, which cared for about 30,000 patients in 1911. The total appropriations for the whole Department of Sanitation for the eight years of its existence, has been about $12,900,000. Of this, however, only about one fourth, or about $380,000 a year, has been expended for sanitation, that is to say, for the prevention of disease. This $380,000 pays for the sanitation of about 100 square miles of territory with a population of about 90,000 or about one cent a day per person.

Figures make dry reading, but indulge me in just one more statistical exposition. The malaria sick rate for 1906, if continued into 1911, would give on the basis of the number of employees in 1911, about 40,000 cases of malaria sick in the hospitals for the year, or a loss in labor of about 200,000 days of work. The total number of employees sick in hospitals with malaria in 1911 was 8,946—or a loss of 44,730 days of work. A gain of about 155,000 days was, therefore, made. Placing the loss to the Government for each day's labor, plus treatment, at the rather low figure of $3 per man, the gain in this one item of saving more than off-set the cost of sanitation proper. These figures do not include the malaria cases treated in the dispensaries and in homes. Among this class of patients the gain has undoubtedly been proportionate to the gain in hospital cases, and in addition it must not be forgotten that malaria is a disease that undermines a man's health insidiously and lowers his working efficiency to an extent not approached by any disease with the possible exception of hook-worm. The less malaria, the fewer inefficient workers in an organization.

The experience of the Panama Canal has demonstrated that proper sanitation, together with what may be called by the modern term of "social welfare work," such as providing proper housing, feeding, and amusements, can make possible residence, even prolonged

(Concluded on page 405.)

Pacific entrance. A typical concrete range-tower.

The Panama Canal and the Commerce of the United States

By Emory R. Johnson, Special Commissioner on Panama Traffic and Tolls

Atlantic entrance. The two-mile harbor breakwater.

THE Panama Canal is being constructed to facilitate the commerce of the United States and of other countries, and to strengthen the efficiency and striking power of the American Navy. The great investment of capital has been made for the purpose of shortening ocean routes, first of all to enable the commerce between the Atlantic and Pacific to be handled more economically, and second, to add to the military power and prestige of the United States.

The economy due to the shortening of ocean routes is measured by the saving in time vessels take to carry freight and passengers from one port to another. The shorter ocean route is ordinarily more economical than the longer one, although it may happen that the circuitous route between the vessel's port of departure and port of destination may be taken, because of greater opportunities for trading on the way, and because of differences in fuel expenses by the alternative routes. To measure the advantages of the Panama Canal to the trade of the United States and other countries, it is necessary, both to consider the effect of the canal upon the length of ocean routes and to take account of relative fuel expenses by the canal and other routes.

The trade between the two seaboards of the United States will derive maximum benefit from the canal. The distance from New York to San Francisco by way of the Straits of Magellan is 13,135 nautical miles, by way of Panama 5,262 miles, the canal route being 7,873 miles shorter. Between New Orleans and San Francisco, the saving in distance is still greater—8,868 nautical miles. The shortest ocean route now used for trade between the two seaboards is the one by way of the Isthmus of Tehuantepec, across which freight is transferred from ship to ship by the Mexican National Railway. The distance from New York to San Francisco via Tehuantepec is 1,016 nautical miles, and from New Orleans to San Francisco, 1,573 miles less than by way of Panama. These differences in distance, however, will not enable the Tehuantepec route to compete with the Panama Canal.

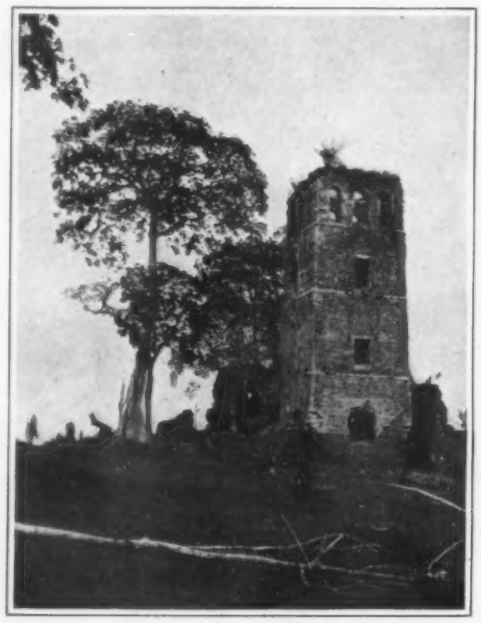
The freight rates of the American-Hawaiian Steamship Company between our two seaboards are said to average about $10.50 per ton and one third of this through rate is paid to the Mexican National Railway for the transfer of cargo from ship to ship. This charge is doubtless profitable to the Mexican National Railway, but it is probable that the cost of getting cargo from ocean to ocean at Tehuantepec could not be brought below $2.50 per weight ton, and it is probable that even with reasonable tolls at Panama the cost of taking traffic from New York to San Francisco by way of Tehauntepec will be $2 per cargo ton greater than the expense of taking the traffic by way of a Panama Canal. The double handling of commodities at the Isthmus of Tehuantepec with the unavoidable breakage and damage incident thereto, together with the greater cost of handling traffic by that route, make certain the impossibility of successful competition of the Tehuantepec route with that via Panama.

The aid given by the Panama Canal to the commerce between the Atlantic-Gulf Seaboard of the United States and the west coast of South America will be the second most important influence of the canal upon commerce as shown in Table I. In computing the time saved, one half day is allowed for the passage through the canal.

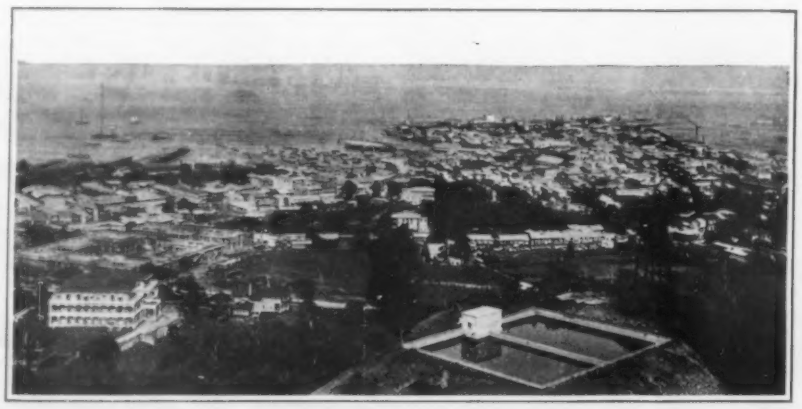
The South American ports selected are located in the northern, central and southern sections of western South America, and the reductions in time given in the table are for vessels of 9, 10 and 12 knots speed—the rate at which most freight vessels are now operated—and for vessels of 14 and 16 knots speed, which represents the rate of passenger steamers over practically all routes, except those across the North Atlantic. Callao, which is the chief port of Peru, is 1,346 miles from Panama and 2,666 miles from the Straits of Magellan, while Valparaiso, the principal port of the agricultural portion of Chile, is 1,433 miles from Panama and 2,616 miles from the Straits of Magellan. The saving in distance and time between the Atlantic Gulf ports of the United States and the west coast of South America is so great that the canal will be used by all the commerce, even though the price of fuel by the canal and the Straits of Magellan routes were the same. As a matter of fact, however, fuel expenses by way of the Straits of Magellan will be much heavier and the amount of space which vessels will have to devote to the transportation of fuel, instead of cargo, will be much larger.

TABLE I.—DISTANCES AND TIME SAVED VIA THE PANAMA CANAL AS COMPARED WITH THE STRAITS OF MAGELLAN BETWEEN THE ATLANTIC-GULF PORTS OF THE UNITED STATES AND THE WEST COAST OF SOUTH AMERICA.

To	From New York.						From New Orleans.					
	Distance saved.	Days saved for vessels of					Distance saved.	Days saved for vessels of				
		9 knots.	10 knots.	12 knots.	14 knots.	16 knots.		9 knots.	10 knots.	12 knots.	14 knots.	16 knots.
	Miles.						Miles.					
Callao	6,250	28.4	25.2	21.2	18.1	15.7	7,245	33.0	29.7	24.7	21.1	18.4
Iquique	5,139	23.3	20.9	17.3	14.8	12.9	6,134	27.9	25.0	20.8	17.7	15.4
Valparaiso	3,747	16.8	15.1	12.5	10.6	9.2	4,742	21.4	19.2	16.0	13.6	11.8
Coronel	3,296	14.7	13.2	10.9	9.3	8.1	4,291	19.4	17.4	14.4	12.3	10.7



Ruins of old Panama which was burned by the buccaneer Morgan.



New Panama, as seen from Ancon Hill.

The effect of the Panama Canal upon the trade of the United States with New Zealand and Australia promises to be of great commercial benefit to the United States. The commerce of the eastern seaboard of the United States with Australia and New Zealand in 1910 was valued at $46,543,000, the increase during the preceding decade having been 68 per cent. Australia has a very large commerce amounting to $130 per capita, while New Zealand's trade averages $170 per inhabitant. The foreign commerce of New Zealand per capita is five times that of the United States. The saving in distance and time of voyages for vessels of 9 to 16 knots speed is stated in Table II.

The distance from New York and Adelaide via the Panama Canal will be 1,746 miles less than via the Cape of Good Hope. To Melbourne, the reduction in distance will be 2,770 miles and to Sydney 3,932 miles. For the voyage between New York and Sydney vessels of 10 knots speed can save 15.8 days. A calculation has been made of the fuel expenses of a 10¼-knot freight steamer whose average daily coal consumption at sea is 38 tons. This vessel would save about $3,500 in coal expenses by taking the Panama route instead of one around the Cape of Good Hope, on a round-trip voyage between New York and Adelaide. For a round-trip voyage between New York and Sydney the fuel expenses via Panama would be about $6,230 less than by way of the Cape of Good Hope. In making this and other calculations referred to in this paper, the 1912 contract prices for coal were taken. It was assumed that the price of coal at Colon or Cristobal would be $5 per ton and at Balboa $5.50 per ton. These prices are about $1 above the cost of coal delivered at the end of ship's tackle on the Isthmus of Panama at the present time. Under present contracts, the United States Government is securing 500,000 tons of coal per annum, delivered at the end of ship's tackle at Cristobal for $4.09½ per ton. It was believed in making the coal calculations above referred to that somewhat less than $1 per ton would amply defray overhead expenses, depreciation of fuel, and lighterage charges, and that the United States Government could, without loss, sell coal, delivered in ship's bunkers, at Cristobal for $5 per ton. The 1912 contract prices for Welsh coal at Port Said, Suez Canal, it may be mentioned in passing, are from $6.20 to $6.32.

For the trade between the Atlantic-Gulf Seaboard of the United States and Oriental countries east of Singapore, the Panama and Suez canals will be competitors. The distance from New York to Hongkong and Manila is about the same via the Panama and Suez routes. For points north and east of Hongkong, the Panama route will be shorter; for places south and west, the distance will be less via Suez as shown by Table III.

If the tolls at Panama are not higher than those at Suez the two routes will be put upon an equal competitive basis as far as toll charges are concerned, and the choice of routes taken by vessels between our Atlantic Seaboard and the Orient east of Singapore, will

depend upon the necessity for and the prospects of securing cargo *en route* and upon the coaling facilities and cost of fuel on the way.

The most effective means of enabling the Panama Canal to compete successfully with the Suez route for the traffic between the Atlantic Seaboard of the United States and the Orient east of Singapore, is for the United States Government to sell coal at moderate cost at the Isthmus of Panama.

The choice of routes taken by vessels between the Atlantic Seaboard of the United States and the Pacific Coast of Asia cannot be predicted in advance with absolute certainty. There will doubtless be much overlapping of routes in the Orient. Some vessels will leave Japanese ports for New York by way of the Suez Canal and Europe, and it is also to be expected that vessels will leave Singapore for New York via Chinese and Japanese ports and the Panama Canal. All things considered, it seems probable that the Panama Canal will be used by most of the traffic handled between the Atlantic-Gulf Seaboard of the United States and the Philippines, Hongkong, and points north and east thereof.

The tonnage of shipping that might have used a Panama Canal in 1899 was carefully investigated and a similar study was made of available canal tonnage for the statistical year 1909-10. It was found, in 1899, that a Panama Canal would then have been used by about 5,000,000 net tons of shipping. The shipping that would have used the canal during the year 1909-10 amounted to 8,328,000 net tons. The increase during the eleven years was 66½ per cent, or at the rate of 59 per cent per decade. Table IV summarizes the results of the investigation of the traffic available for the use of the canal in 1909-10.

The details summarized in the Table IV indicate that the commerce between the two seaboards of the United States during the statistical year 1910 amounted to only about 10½ per cent of the total available canal traffic. The trade of the United States with foreign countries included 33 per cent of the total canal traffic, while the commerce of Europe with the west coast of South America amounted to 38 per cent of the total.

TABLE IV.—NET TONNAGE OF VESSELS THAT MIGHT HAVE ADVANTAGEOUSLY USED A PANAMA CANAL IN 1909-10.

	Total Entrances.	Total Clearances.	Total Entrances and Clearances.
Europe with:			
Western South America	1,553,887	1,594,513	3,148,400
Western Central America and Pacific Mexico	80,788	118,714	199,502
Pacific United States, British Columbia, and Hawaii	419,865	269,853	689,718
Pacific United States via Suez Canal	(1)	(1)	(1) 158,000
Oriental countries east of Singapore and Oceania	618,704	555,881	1,174,585
Eastern United States coast with:			
Western South America, Pacific Mexico, and Hawaii	300,909	166,686	467,595
Pacific Coast of United States (via Cape Horn)	117,147	55,508	172,655
Pacific Coast of United States and Hawaii (via American-Hawaiian S.S. Co.)	181,713	181,713	363,426
Oriental countries east of Singapore and Oceania	600,000	900,000	1,500,000
Pacific traffic:			
Pacific Coast	158,558	259,932	418,490
Atlantic Coast	.....	.....	.....
Eastern Canada with Alaska, Chile and Australia	13,410	22,248	35,658
Total	4,044,981	4,125,048	8,328,029

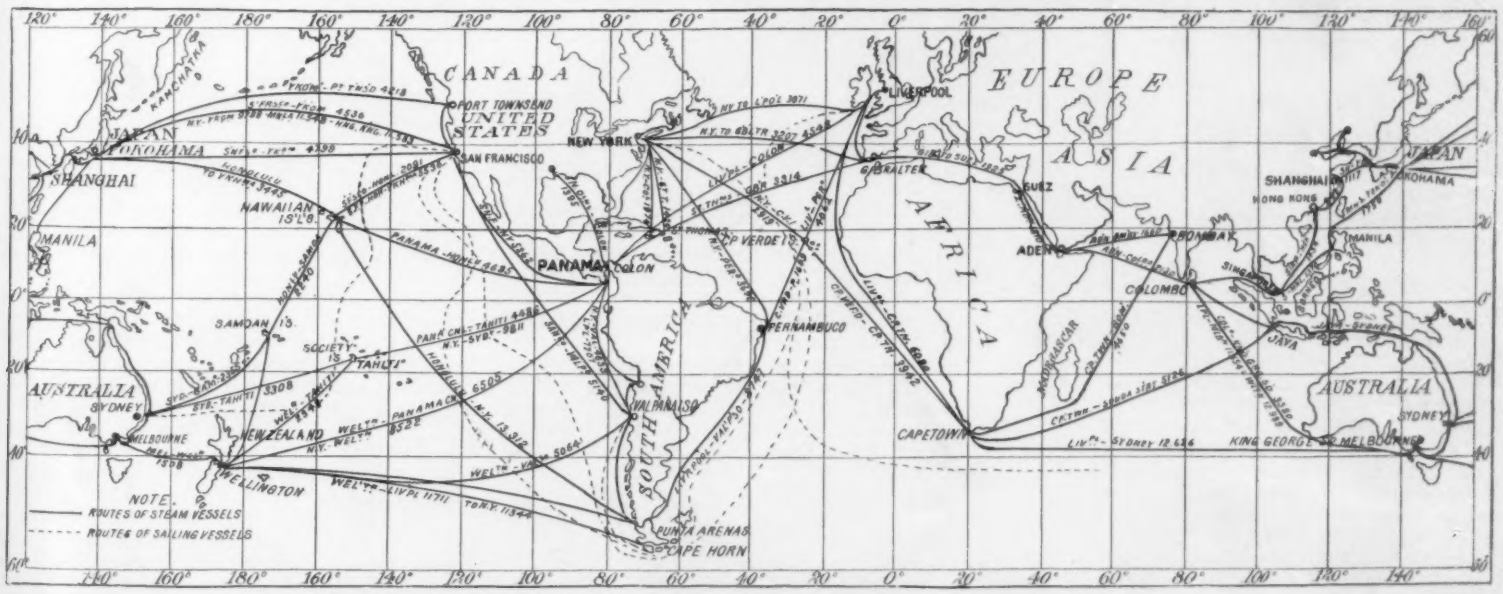
NOTE.—(1) Reported by Suez Canal Company; hence the total is not separable into entrances and clearances at American ports.

In order to estimate conservatively the probable tonnage of traffic that will use the Panama Canal during the early years of its operation, a study was made of the growth of traffic at the Suez and of the increase of the commerce of the world as a whole, and of different sections of the world. The traffic of the Suez Canal increased 70.26 per cent during the decade ending in 1910. The value of the trade of the United States with non-European countries advanced 67½ per cent that decade. These and other percentages of commercial increase make it apparent that an increase of 60 per cent per decade in the shipping using the Panama Canal may be conservatively assumed. At the present rate of increase the commerce available for the Panama Canal during the first year or two of its operation will amount to about 10,500,000 net tons of shipping per annum. Naturally the canal will stimulate the growth of commerce, but if it be assumed that the rate of increase in the canal traffic during the first decade is only equal to the rate at which its available traffic is now growing, the net tonnage of ships using the canal by 1925, at the end of the first decade of the canal's operation, will amount to about 17,000,000 tons per annum. By the end of the second decade the tonnage may be expected to have reached 27,000,000 tons.

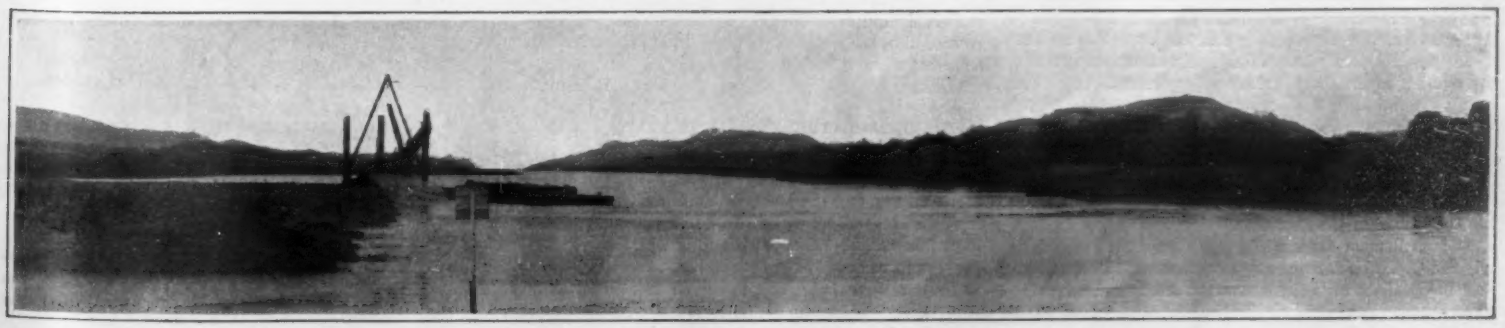
The canal will unquestionably largely increase the tonnage of waterborne traffic between the two seaboards of the United States. The brief table Number V classifies the estimated net tonnage of shipping that will use the canal in 1915, 1920 and 1925.

In the table the tonnage credited to the coast-to-coast American shipping in 1915 was obtained by assuming that the tonnage of traffic handled by water between the two seaboards in 1910 will increase at the average rate at which the total traffic of the canal is growing. Probably it will increase more rapidly than this. It is believed that our intercoastal shipping through the canal will double during the decade ending in 1925. At that rate of growth, the coast-to-coast shipping through the canal will amount to 1,414,000 tons in 1920.

Atlantic entrance. Sea level section of canal, north of Gatun, looking toward Atlantic.



Map showing relation of steamship and sailing lines to the Panama Canal.



Pacific entrance. The sea level section of the canal south of Miraflores locks, showing dipper dredges at work.

TABLE II.—DISTANCES AND TIME SAVED VIA THEPANAMA CANAL AS CONTRASTED WITH ROUTES VIA THE SUEZ CANAL THE CAPE OF GOOD HOPE, AND THE STRAITS OF MAGELLAN BETWEEN THE ATLANTIC-GULF SEABOARD OF THE UNITED STATES AND AUSTRALASIA.

To	From New York.						From New Orleans.						Remarks.
	Distance saved.	Days saved for vessels of					Distance saved.	Days saved for vessels of					
		9 knots.	10 knots.	12 knots.	14 knots.	16 knots.		9 knots.	10 knots.	12 knots.	14 knots.	16 knots.	
Adelaide	Miles. 1,746	7.5	6.7	5.6	4.6	4.0	Miles. 3,258	14.6	13.1	10.8	9.2	8.0	Difference between routes via Panama, Tahiti, Sydney, and Melbourne, and via St. Vincent and Cape of Good Hope.
Melbourne	2,770	12.3	11.0	9.1	7.7	6.7	4,282	19.3	17.3	14.3	12.2	10.7	Difference between routes via Panama, Tahiti, and Sydney, and via St. Vincent, Cape of Good Hope, and Adelaide.
Sydney	3,932	17.7	15.8	13.1	11.2	9.7	5,444	24.6	22.2	18.4	15.7	13.7	Difference between routes via Panama and Tahiti and via St. Vincent, Cape of Good Hope, Adelaide, and Melbourne.
Wellington	2,493	11.0	9.9	8.1	6.9	6.0	3,488	15.6	14.0	11.6	9.9	8.6	Difference between routes via Panama and Tahiti and via Straits of Magellan.

TABLE III.—DISTANCES AND DAYS SAVED BY THE PANAMA OR THE SUEZ CANAL BETWEEN THE ATLANTIC-GULF SEABOARD OF THE UNITED STATES AND JAPAN CHINA, THE PHILIPPINES, AND SINGAPORE.

To	Via	From New York.						From New Orleans.						Remarks.
		Distance saved.	Days saved for vessels of					Distance saved.	Days saved for vessels of					
			9 knots.	10 knots.	12 knots.	14 knots.	16 knots.		9 knots.	10 knots.	12 knots.	14 knots.	16 knots.	
Yokohama	Panama	Miles. 3,768	16.9	15.2	12.6	10.7	9.3	Miles. 5,705	25.9	23.3	19.3	16.5	14.4	Via San Francisco.
	Suez													Via Colombo, Singapore, Hongkong and Shanghai.
Shanghai	Panama	1,876	8.1	7.3	6.0	5.1	4.4	3,813	17.1	15.4	12.7	10.8	9.4	Via San Francisco and Yokohama.
	Suez													Via Colombo, Singapore and Hongkong
Hongkong	Panama							1,919	8.4	7.5	6.2	5.2	4.5	Via San Francisco, Yokohama and Shanghai.
	Suez	18												Via Colombo and Singapore.
Manila	Panama	41						1,978	8.6	7.7	6.4	5.4	4.7	Via San Francisco and Yokohama.
	Suez													Via Colombo and Singapore.
Singapore	Panama													Via San Francisco and Yokohama.
	Suez	2,484	11.0	9.8	8.4	6.9	5.9	547	2.0	1.7	1.4	1.1	0.9	Via Colombo.

TABLE V.—CLASSIFICATION OF ESTIMATED NET TONNAGE OF SHIPPING USING THE PANAMA CANAL IN 1915, 1920 AND 1925.

	Average per annum during 1915 and 1916.	1920	1925
Coast-to-coast American shipping	1,000,000	1,414,000	2,000,000
American shipping carrying foreign commerce of the United States	720,000	910,000	1,500,000
Foreign shipping carrying commerce of the United States and foreign countries	8,780,000	11,020,000	13,850,000
Total	10,500,000	13,344,000	17,000,000

The foregoing details regarding the effect of the Panama Canal upon the length and time of ocean voyages, and the figures presented regarding the traffic of the Panama Canal, show conclusively that the new route between the Atlantic and Pacific will be of great commercial usefulness. Its effect upon the industries and trade of the United States will be large and far-reaching.

Color Photography of the Moon

IN a recent number of the *Astrophysical Journal* Prof. Wood discloses the possibilities of photographing celestial objects by using the visual region of the spectrum alone, the violet region alone, and the ultra-violet region alone. The photographs of the lunar surface taken by Prof. Wood by these three different methods show very marked differences of brightness. A patch just above the crater Aristarchus is as bright as the surrounding surface when the "visual" region is employed, comes out rather darker on the "violet" image, and is quite dark when photographed in the "ultra-violet" light. Some of the *maria* appear darker in the violet picture and appear to be differentiated *inter set* by the selective process. Prof. Wood suggests that, were it possible to take pictures over a great range of different wave-lengths, it would become possible to take up the subject of lunar petrography. A series of experiments led him to the conclusion that the dark patch near Aristarchus is covered by a form of sulphur or some sulphur compound. If it were possible to extend the range of photographs to where the silicates begin to show, by anomalies in reflecting power, one might be able to map out the lunar surface petrographically.

Schaumasse's Comet

A CABLEGRAM received at Harvard Observatory from Kiel gives the following elements and ephemeris of Schaumasse's Comet, computed by Schaumasse and Fayet, of Nice, from observations on October 18th, 19th, and 20th:

ELEMENTS.

Time of perihelion passage	(T)	Oct. 25.31 G.M.T.
Perihelion minus node	(ω)	203° 26′
Longitude of node	(Ω)	270° 24′
Inclination	(i)	53° 53′
Perihelion distance	(q)	1.051

EPHEMERIS.

G.M.T.		R.A. h.	m.	s.	Dec. °	′	Light.
October	26.5	10	19	33	— 7	51	1.00
	30.5	10	30	57	— 12	41	
November	3.5	10	42	37	— 17	25	
	7.5	10	54	30	— 22	02	0.87

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Broken Rail Question

To the Editor of the SCIENTIFIC AMERICAN:

I am following the broken rail question. Your splendid editorial, "The Steel Rail," so far as describing the stresses to which it is subjected is concerned, is complete except the main stress, the "Punch of the Piston," and I have to disagree with the remedy you suggest, better quality, because the heavy traffic demands a very hard rail in order to be durable, and it is this durability feature that renders the rail brittle. Consequently, I am providing a remedy by taking the "punch" out of the locomotive. Mr. C. E. Fisher's letter, "The Rail Question," in which he recounts that an engine in the Middle West broke 150 rails on one trip, proves my argument. What he means by the cause, "not properly balanced," is not understood, because the "punch" is truly alternate, in fact, this is the principal element in creating the "punch"—the rocking motion imparted by the down stroke of the piston alternately on opposite sides. And that two hundred broken rails were removed from a one hundred mile section after one night's traffic would seem to prove that defects were not the sole cause.

St. Louis, Mo. GEORGE J. FERGUSON.

Determinism in Science

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 31st a correspondent who signs himself C. H. K. attacks my statement as to Determinism being the truly scientific standpoint, and advances the argument of common experience in favor of the Free-will theory. I disagree with this to the extent of maintaining that all experience, on the contrary, points to the truth of the deterministic doctrine. All our systems of education, intellectual and ethical, as well as all our social activities, are based on the assumption that human conduct is determined by influences acting upon the will, and that it is possible to a great extent to foresee and to bring about certain lines of conduct as the results of certain causes. According to the Free-will theory, however, we are angry, despondent, foolish, vicious, or whatever, simply because we choose to be so. I cannot think that human nature is so base. I believe that if the will were free we should all be sages or saints.

Your correspondent closes his letter with a query as to which is the more scientific, Free-will or Determinism. Determinism is scientific, Free-will is not. Determinism is simply the universal application of the law of cause and effect. Every phenomenon, psychical as well as physical, arises from a cause—really a complexity of causes—which in turn results from preceding causes, and so on back to infinity. Free-will assumes that psychical phenomena transcend this law of cause and effect, and admits the unthinkable doctrine of chance.

Determinism is not a "lazy man's doctrine," as I have heard it called. It soothes the pangs of defeat it is true; but unto him who has come to realize how ceaseless and deep is the influence of each of us upon the lives of those around him, Determinism acts as a most powerful stimulus to wise and unselfish conduct.

Washington, D. C. PAUL R. BIRGE.

Gyroscopic Action of Revolving Aeroplane Motors

To the Editor of the SCIENTIFIC AMERICAN:

An answer to Mr. Brooke's indictment of the revolving-cylinder motor which appeared in your issue of September 28th, 1912, can be found in the SCIENTIFIC AMERICAN of September 14th, 1912, where on page 231, in the description of a visit to the Gnome motor factory, Mr. Seguin, during the actual tests for gyroscopic action, concludes by saying: "Of course, it exists, but I account for the fact that it is negligible in actual practice in that the plane of rotation of the motor is not changed rapidly enough to produce a noticeable gyroscopic effect."

I asked the late Paul Peck some months ago whether he was troubled by this force, when he replied that he noticed it in the beginning, but after he had gotten used to the motor he found that it rather added stability to the aeroplane flights and that he then forgot all about it.

This is evidently the experience in France, where, I am sure, not less than three fourths of all army aeroplanes are fitted with revolving-cylinder motors; and we hear very little of accidents from that country.

Paul Peck came to his early death because he had the fatal tendency to steep dipping, against which risky habit he had often been warned by a number of people; to lay the blame for the accident to the gyroscopic action of the motor as such is therefore unfair and unscientific.

Even if the gyroscopic force enhanced the danger of steep dipping, which it probably does, it would merely emphasize the folly of this entirely unnecessary and foolhardy practice, and would not diminish the value of light and air-cooled revolving-cylinder motors in the development of the flying art. EMILE BERLINER,

PRESIDENT THE GYRO MOTOR COMPANY.

Washington, D. C.

The Refractory Collar Button

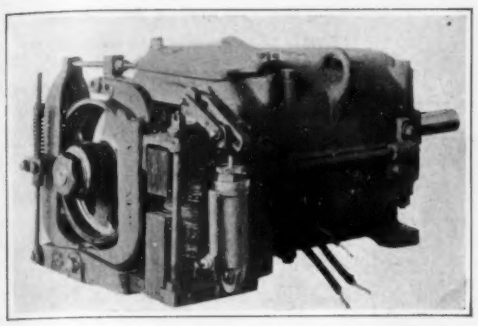
To the Editor of the SCIENTIFIC AMERICAN:

W. S. B. in your issue of August 24th, 1912, advises us to use paraffine on the back of a button-hole to facilitate the passage of a collar button.

As paraffine is not always conveniently near, I suggest something else that we always have with us.

Hold that part of a collar or cuff containing the button-hole between the tongue and the roof of the mouth about three seconds, and the starch will soften, rendering the button-hole so pliable that the most obdurate button will easily pass through.

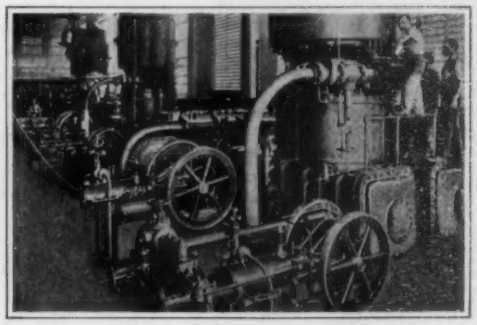
Columbus, O. ORESTE A. B. SENTER.



Type of motor to be used in operating canal.

The Electrification of the Panama Canal

By David B. Rushmore, Member American Institute Electrical Engineers



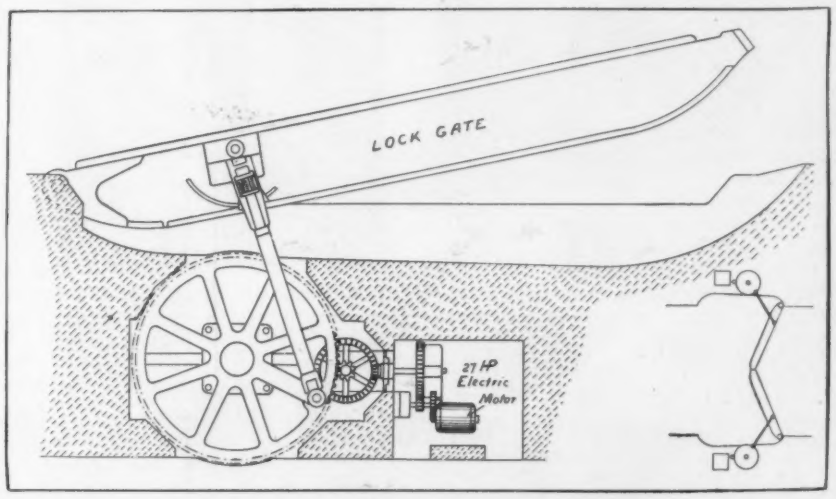
Steam-electric power station at Miraflores.

THE work of digging the Panama Canal has a history of its own. As the operations passed from one company to another, and as man succeeded man in charge of this work, the plans underwent constant modification, and methods of accomplishing such work have passed through a very great evolution. Working side by side on the Isthmus have been machines belonging to different decades of historical development. In the work of construction electricity has unfortunately filled a minor part. Due to the pressure at the time the United States Government took control and the necessity for immediate results, it was impossible to develop the water power on the Chagres River as was planned, and to use electric power for a large part of the work. Also, civil engineers have not utilized electrical machinery to the extent which they will in the future, and the small self-contained steam units were applied much more quickly than could have been done with electricity, even though the final cost for the present methods must necessarily be higher. When we come to the operation of the Panama Canal, however, the situation is entirely changed. Here the present management has had a free hand and electricity will be used throughout all the operation of the machines and appliances incidental to the use of the canal.

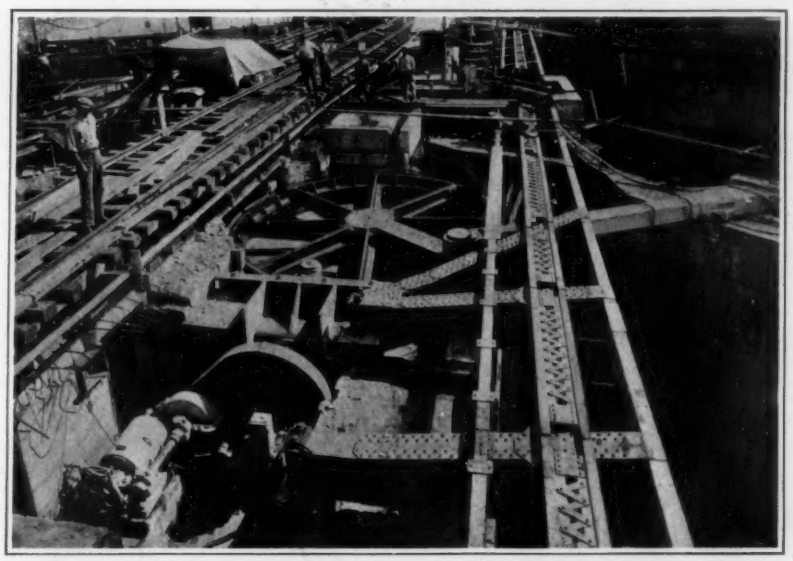
The principal application will be that of 985 motors of 34,300 total horsepower for the operation of the lock gates, fender chains, pumps, etc. Ships will be towed through the locks by powerful electric locomotives, and a large miscellaneous application of electric power will be found in the machine shops, the dry docks, coal handling plant, wharf cranes, and it will be used for many other purposes. Electric lighting will be used wherever possible in connection with the canal and nearby towns in the zone, and the relocated Panama Railroad will possibly be electrified in the near future.

The power will be generated in two large stations, and over one thousand motors will be used for the operation of the canal. Two steam-electric stations now exist at Gatun and Miraflores, each consisting of three 1,500 KVA, 3-phase, 25-cycle, 2,200-volt, steam turbo-driven generators; two 35 Kw., 125-volt turbo-driven exciters with the necessary switchboards, rotary converters, etc. The power station at Miraflores will be retained and power will also be developed from a hydro-electric station in connection with the Gatun dam.

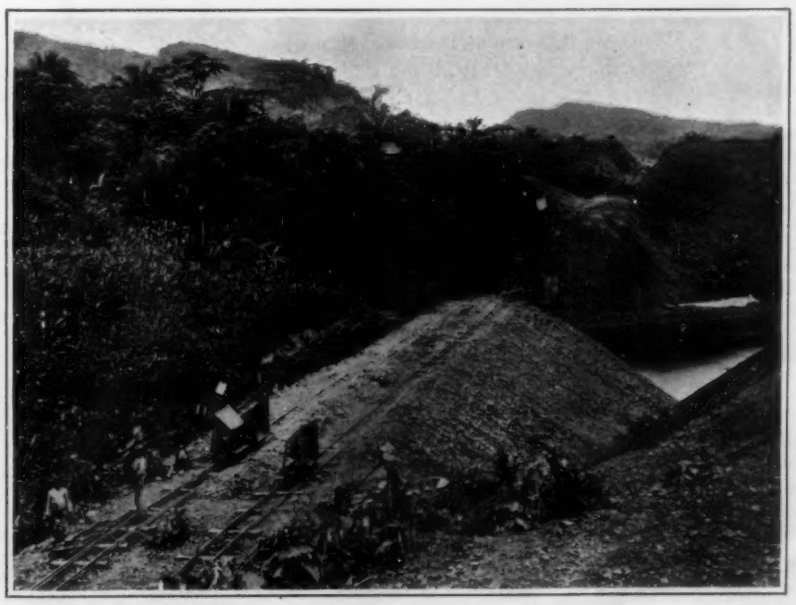
The 165 square miles of storage in Gatun Lake makes possible the development of the hydro-electric station, in which not over 7 per cent of the minimum water supply will ever be used. In the rainy season, water, of course, will be so plentiful that it will be wasted over the spillway. This hydraulic plant will consist of three 2,500 KVA, 3-phase, 25-cycle, 250 revolutions per minute, 2,200-volt, waterwheel-driven, exciters with provisions for three additional units.



Plan view of mechanism for opening and closing gates.



Completed gate-closing gear, showing 27 horse-power motor, gear, and 5-ton arm.



Relocating the Panama Railroad, which will probably be electrically operated.

Protection against severe strains of short circuits will be obtained by the use of external reactances, consisting of air insulated coils mounted on concrete cores. The 50 kilowatt exciters will be mounted on the vertical shaft below the rotating field and above the waterwheel. In addition, there will be two 100 kilowatt induction motor-driven exciters taking power from the main 2,200-volt buses. Remote control will be used throughout and the operator will be located near the switchboard on the second gallery, from which the entire station may be seen.

Two hundred and twenty-volt motors will be used for operating the locks, and transformers located at various sub-stations will be used to step down from the 2,200-volt power of the generating station. The transformers will be located in rooms, each of which will be practically a self-contained sub-station. The Gatun locks will have sixteen such rooms. There will be eight for Miraflores, and Pedro Miguel will require twelve. Every transformer station will have duplicate transformers, of 200 KVA capacity, feeders and buses to provide for a continuous service in case of emergency conditions. Under the usual conditions of operation one transformer will be connected to the locomotive track and the other to the machinery motors. Should either feeder or transformer break down a quick transfer to the reserve unit can be made. In each room there will also be installed a single-phase lighting transformer of 25 kilowatt capacity, and there will be distributed throughout the locks approximately 7,000 lamps. Oil switches of special "foolproof" design, automatic relays, panels, etc., constitute the control equipments; the design of which has been carried out with extreme care to provide for maximum reliability and flexibility of operation, together with the greatest safety for the operators, which latter is of unusual importance in connection with the climatic conditions of the Canal Zone.

Altogether over 1,000 individual motors will be required for the different locks. The most powerful electric motors ever designed for commercial service known are the mill-type motors, which are used for the rough service of steel mills. It is these motors which will be used for the gates, valves, cranes, emergency dams, etc., and they will all be fitted with solenoid brakes. The load curves of these show an extremely intermittent service, and they vary to a considerable extent with the different applications. Apparatus which has been in idleness

(Concluded on page 405.)

The House Fly's Deadly Scourge

PICTURED in the accompanying photograph is a house fly which has been destroyed by the parasitic fungus known as *Empusa muscæ*. This fungus is a deadly enemy of the house fly, and it must destroy myriads of these pernicious insects, especially in the fall. The flies may often be seen in a dead or dying condition on walls, ceilings and window-panes, surrounded by a quantity of white powder, i. e., the spores of the fungus which have fallen from the insect's body. These spores are capable of infecting other flies which may come in contact with them. Whether the flies actually eat the spores, or merely get them attached to their bodies, is not apparently known.

The Bezoar and Its Imaginary Virtues

IN accordance with the ancient idea of ascribing to everything of mysterious or obscure origin, occult, often marvelous properties, the bezoar, not infrequently found in the stomachs of herbivorous and ruminant quadrupeds, goats and antelopes particularly, has been credited with qualities that imparted to it a great value among credulous and semi-civilized peoples, especially in ancient times.

Having as a rule, for its nucleus, some indigestible substance, taken into the stomach with the food, as a measure of protection and to render it harmless, it was gradually coated with a concretion of mineral substance, just as the oyster, coating an intrusive particle with nacreous matter produces the much admired and costly pearl. Sometimes the coating consists of superphosphate of lime and sometimes of phosphate of ammonia or magnesia.

In many instances, the hair carried into the stomach in the course of the licking process by means of which these animals cleanse their coat, would be incorporated with the mineral deposit and felted into a mass of great solidity, the bulk being at the same time greatly increased, so that these accumulations often reached a diameter of several inches. In the stomachs of slaughtered beeves such masses are quite common.

These, however, were not the bezoars that were esteemed for their remedial or protective properties. The latter were compact concretions of mineral matter sometimes radial in structure, sometimes composed of concentric layers and of stone-like hardness. They are classed as Occidental, Oriental and German. It was in the Orient—the land of mystery—that the bezoar enjoyed the widest esteem for its supposed medicinal virtues. The possession of such a concretion was believed to insure the protection of the owner against various diseases, they were also regarded as especially efficacious as an antidote to poisons and even against the bites of the venomous reptiles with which tropical Asia abounds.

While these virtues must be regarded in the light of modern science as of course entirely imaginary, the ownership of such a protection may have proved, to some extent, an involuntary and hypnotic aid to the sufferer. As a consequence, considerable value was often attached to notably fine specimens of bezoars. In India, especially, their value increased enormously in proportion to their size and choice specimens commanded very large prices.

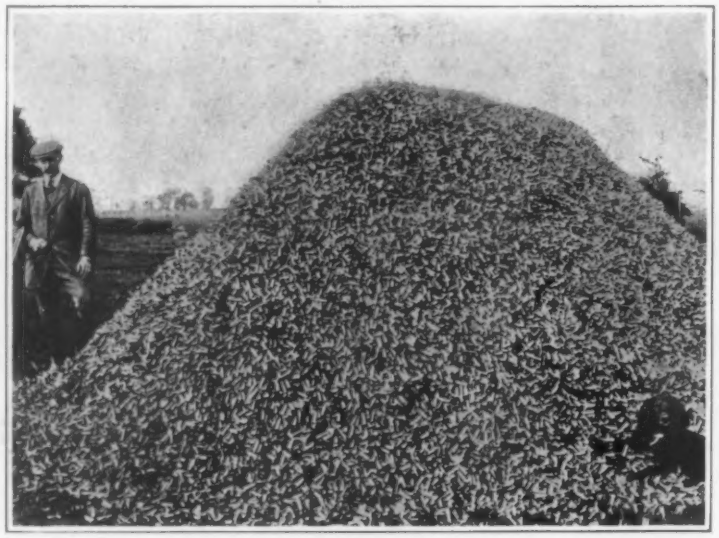
They were mounted, according to their dimensions, for display or for suspension from the person, special care being taken to leave the bezoar substance plainly visible. In many instances, as the accompanying illustrations, made from photographs of gold-mounted specimens preserved in the Court Museum at Vienna demonstrate, they were even in Europe thought worthy of being inclosed in costly and artistic settings, by which, of course, their value was enhanced to a corresponding extent.

Readers are invited to contribute photographs of novel and curious objects, unique occurrences and ingenious contrivances. Such as are found available will be paid for promptly.

Fly destroyed by a parasitic fungus.

Hickory bark carved by beetles.

Gold-mounted bezoars in Vienna Museum.



A mound of 13,000,000 cartridge cases.

The largest fire engine in Europe over the largest ship in the world.

Wood Carving by Beetles

THE accompanying photograph, sent to us by one of the readers of the SCIENTIFIC AMERICAN, shows two pieces of hickory bark that have been curiously carved on the inner surface, producing spider-like effects. The carving was done by beetles whose energies have evidently been directed by a common impulse or instinct which has led them to eat out geometrical designs in the bark. The specimens were picked up in North Carolina.

Marking Sheep Without Injury to Wool or Skin

M. ROLLIN has just described to the National Society of Agriculture of France an excellent method of marking sheep, reported in *Les Annales*.

The sheep can be branded with a hot iron only on the cheeks or forehead, which are bare of wool, or on the horns. Hence many farmers and merchants make use of pitch or coal-tar to mark the wool. But these substances become inseparable from the wool. "Or rather," as Rollin remarks, "they melt and spread when the grease is being removed from the wool, blackening and soiling the fleece."

Traces of them are found in all ulterior operations, and even in the tissues. Skin and wool dealers buy such fleeces at reduced rates. Hence it is desirable to find another method of marking. It has been proposed to use aniline colors, but this is even worse, since the colors do not merely soil the fleece, but actually *dye* it.

Other means are not lacking, notably that of tattooing the ear of the sheep. Also, a small metallic plate can be fastened in the ear, as is done with African sheep to prove that they have been "*clavelized*," i. e., inoculated with the special serum which combats their dangerous and contagious eruptive malady, rot or scab.

The Syndical Chamber of Commerce and Industry advises the employment of a color composed of linseed oil, essence of turpentine and Prussian blue or similar color. It recommends marking on nose, forehead, or nape of neck.

Thirteen Million Cartridge Cases

AT first thought one might be inclined to think that the accompanying photograph showing a mound of 13,000,000 cartridge cases was taken on some battlefield in the Balkans. These are not rifle cartridges, however, but paper shells from shotguns and the pile was collected at the Hendon School of Shooting in England. It is a testimony to the love of hunting for which the British are noted, and it shows how the Englishman will take infinite pains to make himself proficient in this class of sport.

Testing the "Imperator's" Bulkheads

THE giant transatlantic liner "Imperator," which is rapidly nearing completion at Hamburg, Germany, recently underwent a very rigid test in order to determine the efficiency of her bulkheads under extreme conditions. A number of the compartments were filled with water to prove the strength of the steel bulkheads. The water was then pumped out by the largest fire engine in Europe. The accompanying photograph shows the "Imperator" at her dock with the great fire engine being lifted to her deck. As compared with the enormous bulk of the great liner, the fire engine is very insignificant. The test proved that the bulkheads would be equal to an emergency such as befell the ill-fated "Titanic." To further safeguard the "Imperator," efficient mechanism is being installed for launching lifeboats under unfavorable conditions. Anti-rolling tanks in the vessel will remove the danger of the lifeboats being crushed against the sides of the ship while being lowered. One of the lifeboats is equipped with a wireless telegraph system having a range of 200 miles, the antennæ being a telescopic mast. This lifeboat will serve as the flagship of the fleet of lifeboats in case of a wreck.

Fortifying the Canal

(*Continued from page 385.*)

world for the protection against capture by an enemy of objects of value to the security of nations. In all these cases we find that it is by fortification. Sea coast cities, naval bases, the Kiel Canal, are protected in this manner. Nor is the Suez Canal an exception to this rule. England, with her fortresses at Malta and Aden, her garrisons in Egypt, and a navy superior to that of any other two powers, has assured herself that there will be no violation of the terms of the Constantinople convention. And, as a matter of historical fact, England herself did not consent to the neutralization of the Suez Canal so long as the unsettled conditions of her occupation of Egypt rendered it at all likely that she might have to use the canal as a military asset. At the time of the convention of Constantinople in 1888 in regard to the Suez Canal, the British delegates made the following reservation:

"The delegates of Great Britain in presenting this text of a treaty as the definite regime intended to guarantee the free use of the Suez Canal, considered it their duty to formulate a general reservation as to the application of its provisions in so far as they would not be compatible with the transitory and exceptional state in which Egypt now exist and as they might fetter the freedom of action of their government during the occupation of Egypt by forces of her Brittanic majesty." (Studies in International Law. T. E. Hall, p. 293.)

It remains to consider briefly certain military objections which have been made to the policy of fortification. In the first place, it has been objected that fortifications were unnecessary for the canal, on the ground that its defence would be assured by our naval forces. This objection arises from a complete misconception of the true function of the navy. The relative function of the land forces in defence of the canal will be the same as in the defence of any other part of our sea coast. The navy can be used to advantage only when operating on the offensive; and it will be free to operate in this manner and to go where it can do the most good, only when our vital interests are not dependent for protection on it alone. To relegate the navy to the rôle of passive defence, and to tie it down to one locality, would not only be the most expensive possible form of protection to the canal, but it would concede to the enemy at once the command of the sea, and permit him to operate unhampered, without danger of interference by our fleet, against all other portions of our coast line. It is in recognition of these principles that the United States, as well as all other powers, has provided fortifications and armed forces for the protection of its important seacoast cities, dockyards, and naval bases. It was due to the securely defended condition of the Japanese ports that their fleet was free to seek out its proper objective—the Russian fleet—without fear of interruption or recall to guard its home ports against raids by the Vladivostock squadron. To secure an effective protection for the canal by means of naval forces only, without at the same time unduly exposing our seacoast to naval attack, would involve an expenditure for battleships so great as probably to be found prohibitive; an equal degree of protection can be maintained by means of fortifications and a military garrison at a very small percentage of such cost.

Again, it has been objected that the canal is so isolated with respect to the United States that it will be impracticable to secure its successful defence. The fact is, on the contrary, that the Panama Canal Zone is unique in its possibility for reinforcement from the United States. Situated as it is upon two oceans, its position lends itself better to a successful defence than does any other of our oversea possessions. Communication with Porto Rico, Alaska, Hawaii, Guam, or the Philippine Islands, can be had by only one ocean. If any enemy gain the naval supremacy on the ocean on which any of these latter possessions are situated, communication with the United States will be interrupted and the possibility of reinforcement stopped. Communication between Panama and the United States, on the other hand, can be had by both the Atlantic and the Pacific oceans. So long as the United States holds the canal, it will be impracticable for the enemy to interrupt communication in both oceans; and consequently the garrison of the Canal Zone can always be reinforced by troops from the United States. Moreover, the canal is much nearer us than it is to any other power of sufficient military strength to be able to dispatch a large force in transports against the Canal Zone. The defence of the canal virtually reduces to the problem of protecting it against the action of a hostile fleet, and against such landing parties as can be afforded from such a fleet. Against attack from a hostile army, the canal can be reinforced by us more quickly than the attack can be made.

Another objection that has been advanced to the fortification of the canal is the assertion appearing in an article in *Hampton's Magazine* for March, 1910, over the signature of Admiral Evans, and given wide publicity, to the effect that the topography at the Atlantic terminus of the canal is such that fortifications, no matter how strong, would not be sufficient to keep a hostile fleet at such distance from the mouth of the canal as to prevent its destroying our fleet in detail as it emerges in column. As to this, I need only state that since the objection was made the entire matter has been referred to the General Board of the Navy, and its investigation and report has shown that the objection is entirely unfounded. Their report makes it clear that if the Atlantic terminus of the canal be fortified, a fleet can emerge from that terminus in the face of a hostile fleet with less danger of damage from the enemy's fire than if emerging from New York city, Boston, or Hampton Roads. I quote certain pertinent portions of the report:

"The General Board believes that the proposed fortifications at the termini of the Isthmian Canal would be invaluable in assisting the transfer of a United States fleet from one ocean to the other, through the canal, in the face of an opposing fleet. The function of the fortifications in this particular is precisely the same at the canal termini as it is at any fortified place from which a fleet may have to issue in the face of an enemy's fleet.

"Guns mounted on shore are on an unsinkable and steady platform, and they can be provided with unlimited protection and accurate range-finding devices. Guns mounted on board ship are on a sinkable, unsteady platform, their protection is limited, and range-finding devices on board ship have a very limited range of accuracy. The shore gun of equal power has thus a great advantage over the ship gun which is universally recognized, and this advantage is increased if the former be mounted on disappearing carriages, as are the seacoast guns of the United States. The mere statement of these elementary facts is a sufficient proof of the value of seacoast guns to assist a fleet in passing out from behind them to engage a waiting hostile fleet outside, provided the shore guns are mounted in advance of, or abreast, the point where the ship channel joins the open sea. Even if somewhat retired from that point they would be useful, but to a less extent.

"At the Pacific terminus of the canal, there are outlying islands that afford sites for fortifications, the usefulness of which in assisting the egress of a fleet in the face of opposition is universally admitted, as far as the General Board knows; but there has been unfavorable criticism of the possibility of fortifications at the Atlantic end to serve this purpose. The General Board regards these criticisms as unfounded and believes, on the contrary, that the conditions at the Atlantic terminus of the canal are unusually favorable for the emplacement of guns that would be of assistance to a fleet issuing in the face of hostile ships.

"On both sides of Limon Bay, in which the canal terminates at the Atlantic end, there are excellent sites for forts, well advanced on outlying points. The line joining these sites is 3,000 yards in front of the point where the canal prism reaches a low water depth sufficient for battleships, and Limon Bay from this point outward is wide enough for a formation of eight ships abreast. The outer end of the most advanced breakwater proposed is only 600 yards in front of the line joining the sites for the forts; and as long as ships remain behind the breakwater, it will afford them a considerable amount of protection from the enemy's fire, while they will themselves be able to fire over it. In order to make his fire effective against the issuing ships the enemy must come within the effective fire of the fortifications. Under these circumstances it is impossible to deny the usefulness of fortifications in assisting the issue of a fleet against opposition. The conditions in this respect at the Atlantic end of the canal are incomparably better than those existing at Sandy Hook, whose forts nobody would dream of dismantling."

To sum up, fortifications and a military garrison will serve the same purpose on the Panama Canal Zone as is served by the fortifications and garrisons in and around our important seacoast cities. They will free the fleet and permit it to fill its legitimate functions in seeking out an opposing fleet of the enemy; they will prevent the bombardment of the locks and operating machinery (which are not, as has sometimes been asserted, too far inland to be damaged by ships' fire); they will enable our fleet to be transferred in safety from one ocean to the other in the face of an opposing fleet; and they will prevent the destruction or seizure of the canal by a raiding force of the enemy. They are the only means, other than those which would arise through the adoption by the United States of a naval policy similar to that of England, by which the United States may assure to itself the continued possession and control of the canal.

In this discussion I have avoided criticism of the efficacy of international agreement or treaty to accomplish the ends at which the treaty is aimed. I have assumed for the purpose of argument that the treaty or international agreement when made will not be broken under the stress of war. As a matter of fact, we have no right to make such an assumption in regard to a matter of such vital national interest as the security of the Panama Canal. Turkey and Korea are two recent examples of nations which have intrusted the maintenance of their national integrity and home defences to the protection of international agreements. The independence of Korea was guaranteed by four of the great powers in 1902. It had been previously acknowledged by the treaty of Shimonoseki in 1895 between China and Japan; yet on February 9th, 1904, less than two years after the later guarantee, the Japanese naval commander at Chemulpho violated with impunity the independence of that port and notified the Russian commander of the fleet that unless he left the harbor he would be attacked at his anchorage, and at the same time warned the commanders of the neutral vessels present in the harbor to take measures for the safety of their ships.

Shortly after this incident Japan established in effect a protectorate over Korea, which has been described by an authoritative English writer on international law as constituting "an undoubted infraction both of the treaty of Shimonoseki and of the Anglo-Japanese convention."

Even as I write the Turkish army in front of Constantinople is fighting to accomplish what none of the great powers who were parties to the treaty of Berlin and interested in the preservation of the Ottoman Empire has, as yet, lifted a finger to effect.

In 1908 Austria-Hungary annexed Bosnia and Herzegovina, notwithstanding the fact that Austria-Hungary was one of the seven signatory powers to the treaty of Berlin in 1878, which left the sovereignty of Bosnia and Herzegovina with Turkey. This action, while supported by one and resented by other signatory powers, invoked nothing more from any of them than an expression of dissatisfaction. The incorporation of Eastern Roumelia with Bulgaria, and the declaration of independence by the latter country in 1908, were further violations of the treaty of Berlin; violations that also were permitted to pass without effective protest by the signatory powers to that treaty. In the words of an eminent authority on international law, these acts have "demonstrated how worthless the treaty of Berlin is in restraining political action in the Balkan Peninsula."

In 1790 the Kingdom of Prussia guaranteed the independence of Poland; in 1792 Prussia played the leading part in the partition of Poland. In 1807 Great Britain, without any excuse, except that she deemed it necessary to her military policy, entered the harbor of Copenhagen, belonging to a nation with which she was at peace, and ruthlessly destroyed the Danish fleet.

These instances, selected at random, serve to indicate that it is not always wise or prudent to trust the protection of an invaluable national possession to international agreement or treaty faith. They serve to justify the remark of Mr. W. E. Hall, perhaps the most eminent living authority on international law, to the effect that "treaties are only permanently obeyed when they represent the continued wishes of the contracting parties."

III. Character of the Fortifications and Defences.

Necessarily only a general description of these can be given. What has been said heretofore indicates the object of such fortifications and the purpose which they are intended to subserve. The defences to the Isthmus are divided into two general heads:

"1. A seacoast armament with submarine mines at the termini of the canal, for protection against a sea attack and to secure a safe exit for our fleet in the face of a hostile fleet.

"2. The construction of field works and a mobile force of troops to protect the locks and assure important utilities against an attack by land."

The seacoast fortifications will include 16-inch, 14-inch, and 6-inch rifles, and 12-inch mortars. This armament will be of more powerful and effective types than that installed in any other locality in the world. At the Atlantic end of the canal the armament will be located on both sides of Limon Bay. At the Pacific end the greater part of the armament will be located on several small islands, Flamenco, Perico and Naos, which lie abreast of the terminus. Submarine mines will complete the seacoast armament and will prevent actual entry into the canal and harbors by hostile vessels.

In addition to these fortifications, and the necessary coast artillery and garrison to man them, the defensive plans provide for the erection of field works, and for the maintenance at all times on the Panama Canal Zone of a mobile force consisting of three regiments of infantry, at a war strength of nearly 2,000 men for each regiment, a squadron of cavalry, and a battalion of field artillery. These latter fortifications and the mobile garrison are intended to repel any attacks that might be made by landing parties from an enemy's fleet against the locks and other important elements or accessories to the canal. As an attack of this character might be coincident with or even precede an actual declaration of war, it is necessary that a force of the strength above outlined should be maintained on the Canal Zone at all time. This mobile garrison will furnish the necessary police force to protect the Zone and preserve order within its limits in time of peace. Congress has made the initial appropriations for the construction of these fortifications, and they are now under construction. A portion of the mobile garrison is also on the Isthmus, and the remainder will be sent there as soon as provision is made for its being housed.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

CAP.—C. I. MINKOFF and L. KRONTHAL, 137 Grand St., New York, N. Y. This invention relates generally to caps and more particularly to adjustable caps, such as disclosed in the U. S. Letters Patent issued to these inventors. The construction and arrangement is such that one cap may be worn by persons requiring caps of different sizes.

SKIRT MARKER.—MARIE ANDERSEN, 267 51st St., Brooklyn, N. Y. The primary object of this invention is the production of an apparel apparatus which will be of simple and comparatively cheap construction and which may be used by any woman whereby she may fit her own skirt with ease and accuracy.

Electrical Devices.

CIRCUIT CLOSER.—C. A. CASTLE, Oldham, S. D. This invention provides a closing device adapted to be connected across the lines of a telegraph circuit at a station whereby, if the key within the station should be left open or a plug between the key and the connections to the circuit closer be removed, thereby opening the line, the device will be actuated by means of a local circuit in order to close the line.

TELEPHONE RECEIVER HOLDER.—S. C. SLADDEN, 305 5th Ave., Manhattan, N. Y., N. Y. The invention provides a holder which, when disposed in service, is mechanically supported; provides a support which, when released from service position, automatically opens the telephone circuit and to close the bell circuit; provides a holder arranged to compel the proper disposition of the parts of the instrument; and provides a holder in the shape of an attachment to the ordinary telephone instrument, adapted for use thereon without altering or interfering with the construction of the instrument.

Of Interest to Farmers.

CULTIVATOR.—R. C. DOUGAN, Drawer 7, Millersburg, Ohio. The intention in this case is to provide a simple device which will thoroughly work up and disintegrate the soil, and wherein means are provided for guiding or steering the cultivator as it is drawn through the field.

HOEING MACHINE.—W. R. STURGIS, 519 Concert St., Keokuk, Iowa. The object here is to provide a simple, easily operated and economical machine wherein mechanism is provided for hoeing and thinning of plants in a manner closely resembling the thorough operation of hand working.

HEATING SYSTEM FOR INCUBATORS.—G. H. LEE, 1115 Harney St., Omaha, Neb. This inventor provides means whereby the temperature in an incubating chamber may be distributed to equalize or vary the temperature of various parts of the chamber at will; provides means for arresting the smoke or fumes emanating from the ordinary heater lamp; and provides registers for regulating distribution of the heat.

Of General Interest.

TILE SETTER.—G. W. MCGANDY, Marshall, Minn. This improvement involves a device for use in setting tiles in position in wells or similar excavation, and the principal purpose of the invention is the provision of a device which will perform the work in an efficient manner.

NEWSPAPER HOLDER FRAME.—H. ZUM FELDE, 758 E. 225th St., New York, N. Y. This invention preferably comprises an arrangement of supporting bars in which is mounted a number of spring-pressed rods adapted to engage the top of a pile of papers with sufficient force to hold them in place against gusts of wind, but not too tightly to prevent them from being pulled off the pile, without loosening the rods by the customer.

PHOTOGRAPHIC PRINTING DEVICE.—M. F. LONG, 110 W. Superior St., Duluth, Minn. Light entering this device will not be transmitted directly to the negative from which the photographic print is to be made, but will first fall upon a mirror carried on the interior of the casing of the printing device and be caused to pass, by reflection, therefrom to a suitable opening in which the negative is held in place. Suitable plates modify the light passing into the device when the paper to be printed is put into position, the object being to illuminate the negative with non-actinic rays, to allow the user to see where to place paper on the negative at the start.

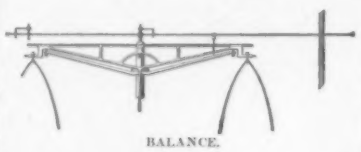
AIR SUPPLY DEVICE FOR FIREMEN.—J. D. HALLORAN, 56 Baxter Ave., Elmhurst, L. I., N. Y., N. Y. This device utilizes the action of the water passing through the fire hose for drawing in fresh air and delivering the same to one or a number of firemen for breathing purposes, thus enabling those in charge of the fire to readily combat a fire in the holds of vessels, cellars, etc.

FINGER EXERCISER.—J. R. MANNERS, P. O. Box 115, Jefferson, Ind. The object of the invention is to provide a simple device adapted to engage certain fingers of either hand and leaving any desired finger free, whereby that finger may be exercised in various ways depending on the calling of the person.

REFUSE RECEPTACLE.—S. MEYROWITZ, 293 Stockton St., Brooklyn, N. Y. An object here is to provide a refuse receptacle with a cover which can be readily opened for the purpose of depositing refuse therein, and with an auxiliary door or cover which can be opened for the purpose of removing the refuse from the receptacle.

Hardware and Tools.

BALANCE.—G. VOLAND and G. G. VOLAND, New Rochelle, N. Y. For the purpose of this invention use is made of a rider rod provided with a resilient finger adapted to engage the beam on turning the rod with a view to impart a swinging motion to the beam to test the sensitiveness thereof. Use is also made



BALANCE.

of a rider supporting arm held on the rider rod and provided with a hook for supporting the rider, and a stop lug in the rear of the hook to prevent the rider from slipping back on the arm. A side elevation of the rider carrier, as applied to a balance in dormant position, is shown in the engraving.

DEVICE FOR FASTENING SHADES TO ROLLERS.—G. W. FOUNTAIN and S. H. HOOK, Cameron, Mo. This invention provides an elongated flexible fastener with projections on one face for engaging the shade and the roller, there being a slot at one end of the fastener, in which a pointed terminal at the other end is normally disposed and turned over, for holding the fastener around the roller and an end of the shade, the fastener being provided with laterally extending shoulders for engaging and holding the end of the shade in place.

SUPPORT FOR TOOLS.—J. J. DELEHANT, 652 W. 47th St., Chicago, Ill. This improvement pertains to supports for tools, the more particular purpose being the provision of a neat, handy, and simple form of portable support for such tools as are usually employed by carpenters, steam fitters, plumbers, and the like.

SHADE SUPPORT.—A. B. SMITH, care of E. Witzman & Co., 99 N. 2d St., Memphis, Tenn. The two telescopic members of the support have brackets for carrying the shade roller, each of the members having lugs around which a cord is disposed so that the members are held firmly to the cord when it is drawn taut, the cord being disposed around pulleys which are mounted to permit of the cord being conveniently drawn taut, and the pulleys so supported that they are readily removed and replaced.

SAFETY RAZOR.—D. W. WOOD, care of McNutt & Shattuck, 12 Knight Block, Brazil, Ind. In this instance the invention refers to safety razors, and the aim is to provide a razor which is adapted to all portions of the face, and which will give a transversely shearing cut when drawn longitudinally across the same.

Heating and Lighting.

OPENING DEVICE FOR FURNACE DOORS.—J. WHEELER, 311 So. 2d St., Cripple Creek, Colo. Mr. Wheeler's invention refers to a device for opening doors of furnaces, especially engine furnaces. An object is to provide means whereby the door of a furnace may be opened by stepping on a pedal and will automatically close when the pedal is released.

STAY BOLT AND MEANS FOR SCREWING THE SAME IN PLACE.—W. L. DECKER, per Callcia No. 9, Mollendo, Peru. This invention has in view a means for rigidly connecting the inner and outer walls of the boiler with each other and thus prevent the walls from bulging under pressure, and permitting of conveniently and quickly screwing the stay bolt in place or removing it when necessary.

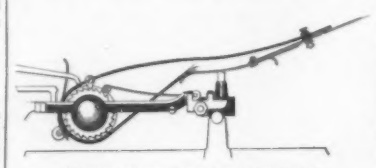
COMBINATION GAS BURNER AND ELECTRIC GAS IGNITER.—H. D. GRINNELL, Agricultural North Bank Bldg., Pittsfield, Mass. This invention is for use on acetylene or other gas lamps for illuminating purposes on automobiles and other places, and arranged to prevent electric wires from disturbance and to insure proper transmission of electricity to the electrodes used for producing a spark in the path of gas issuing from the burner of the lamps to ignite the gas whenever it is desired to use the lamp.

Household Utilities.

COOKING APPARATUS.—HARRIET J. FELL, care of Dorrilton, Broadway & 71st St., New York, N. Y. This apparatus is for use in broiling, toasting or otherwise treating articles of food, and is arranged to permit of conveniently holding the article of food in position in a holder or gridiron to allow of readily turning the holder or gridiron periodically and locking it in the adjusted position.

Machines and Mechanical Devices.

PAPER GUIDE.—ALICE U. DAVIS, Box 910, El Paso, Tex. This invention provides means for guiding the paper and carbon inserts to and from a typewriting machine cylinder, to prevent the disarrangement of the sheets of paper or carbon inserts carried thereby, after delivering from the platen; and provides means for holding the paper, which are light, simple and durable in construction. An advantage in the use of the device is that the limp car-



PAPER GUIDE FOR TYPEWRITERS.

bons are prevented from falling or curling between the leaves of the paper before the paper and carbons enter the paper feeding device, thus preventing blank spaces on the carbon copies. The illustration gives a side view of a fragment of the frame of a typewriting machine, showing in conjunction therewith means for guiding the paper on delivery from the platen.

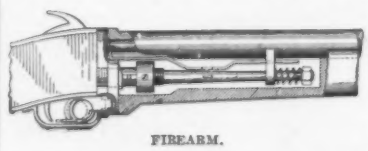
SAFETY DRAWBRIDGE ATTACHMENT.—E. F. SCHOENTHALER, Long Branch, N. J. By means of this attachment the entrance to either or both sides of the drawbridge may be guarded when the bridge is open, so as to prevent accident. An object is to provide means whereby a single man can manipulate the guard gates at the bridge entrance from

SAFETY DRAWBRIDGE ATTACHMENT.

a point where the manipulation of the bridge itself is controlled, such as the engine-house on the bridge. The gates can only be opened conveniently when the bridge has returned to its position in alinement with the roadway, the gates being operable either from above in the engine-house, or below on the bridge itself. The engraving represents a perspective view broken away to show the underlying structure.

REGISTERING PHYSICAL EXERCISING MACHINE.—A. E. HARTIG, 4906 N. Western Ave., Chicago, Ill. In this case the aim the invention has in view is the provision of an exercising machine with a registering mechanism for the purpose of showing the total number of pounds of force exercised in the employment of the machine.

FIREARM.—B. F. CASE, P. O. Box 218, Mitchell, Ind. This inventor provides a firearm having an extractor movable longitudinally of the barrel, and rotatable therewith on a stud mounted on the breechpiece, so that



FIREARM.

when the barrel is rotated the extractor will engage a member on the stud, which will hold the extractor against movement when the barrel is moved longitudinally away from the breechpiece, the extractor in this way removing from the barrel the shell. A side elevation of the firearm is shown herewith partially in section, the firearm ready to be fired.

ATTACHMENT FOR TYPEWRITERS.—L. LAMARQUE, San Miguel 226 Altos, Habana, Cuba. This invention facilitates the winding and unwinding of the typewriter ribbon; provides means for printing at practically a single stroke, an entire line or part of a line or repeated characters, such as dots or stipples; and provides a special mechanism for carrying out these purposes and improving generally the efficiency of the typewriting machine.

Prime Movers and Their Accessories.

AUTOMATIC SPARK ADVANCER.—C. C. CHARLES, Hoisington, Kan. The invention comprises suitable apparatus for operating the casing of the timer which closes the circuit supplying current to the igniter, in such a way that when the engine speed increases, the instant at which the circuit is closed to operate the igniter is automatically advanced so as to cause the spark to be produced at the required point before the piston reaches its inner dead center.

Railways and Their Accessories.

CAR COUPLING.—AUGUSTA L. ROBERTS, care of Bertha L. Kahne, 900 W. Front Ave., Ashland, Ky. In this instance the invention pertains to railway draft appliances and has particular reference to draw bars or couplers which are much more reliable in operation than those previously proposed or commonly used and which in the case of breakage, may be more readily and cheaply repaired than usual.

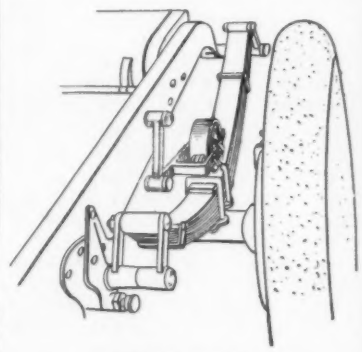
Pertaining to Recreation.

TOY BOOMERANG.—G. H. LEE, 1115 Harney St., Omaha, Neb. The invention provides a missile which when properly thrown has a trajectory similar to that of a boomerang, returning to or near the thrower; provides a missile the trajectory of the flight whereof is spiral; and constructs a toy in the simplest and most durable form.

Pertaining to Vehicles.

ELECTRIC DRIVING GEAR FOR MOTOR VEHICLES.—W. H. DOUGLAS, care of Healy & Co., 1652 Broadway, N. Y., N. Y. The inventor provides a motor drive for automobiles and other vehicles, arranged to insure proper transmission of the power from the motor to the axle to counterbalance the motor and driven parts, and to allow the motor to oscillate in any direction, thus compensating for jolts and twists incident to running over rough roads.

REBOUND CHECK.—W. A. FINLEY, Fairmount, West Va. This appliance eliminates the rebound of a car without interfering with the downward action of the springs. A rebound prevents the much desired resiliency of the spring and makes the shock to the chassis more violent. This device runs idle on the downward action of the car body and, therefore, receives half the wear of other devices



REBOUND CHECK.

designed for this purpose. All working parts of this device are housed and the gear case is packed in grease and rendered noiseless. Spring action against the wedge keeps the moving parts in contact thus avoiding any hammer or rattle. The noiseless heavy duty ratchet will operate on the instant it is reversed, and this is a feature aside from its application to the motor car. The drawing shows a perspective view of the invention in place.

Designs.

DESIGN FOR A REINFORCED KETTLE.—E. C. HOFFMANN, care of H. M. Kidder, Scribner, Neb. This ornamental design is of a reinforced kettle of excellent proportions and outlines of graceful curves.

DESIGN FOR A COVERED DISH OR SIMILAR ARTICLE.—C. E. ZIEGLER, Altwaser, Germany, care of W. Guerin & Co., 33 Park Place, New York, N. Y. This oval shaped covered dish has a handle at each end of and midway of the body of the article, and from these the body slants toward the cover and the base. The last is flat and the cover is rounded with a handle in the center. The design is beautiful in its simple outlines.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We are prepared to render opinions as to validity or infringement of patents, or with regard to conflicts arising in trade-mark and unfair competition matters.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & Co.,
Patent Attorneys,
361 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

PATENT ATTORNEYS

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

MUNN & COMPANY

361 BROADWAY, NEW YORK

Branch Office, 625 F Street, Washington, D. C

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS WANTED

AGENTS—One cent invested in a Postal Card will bring you a $35 to $60 a week proposition. For further particulars communicate with American Aluminum Co., Div. 1029, Lemont, Ill.

BUSINESS OPPORTUNITIES

GEIPEL & CO., of Vulcan Works, St. Thomas Street, London, S. E., England, desire to appoint a first-class firm as licensees to manufacture and sell under U. S. Patent No. 846,300 their new Rapidity Steam Trap, adopted by the English and other Navies, and principal steam users throughout the world.

YOUNG INVENTOR desirous of devoting his entire time to the subject of invention, wishes to hear from men of means. Address, Inventor, Box 773, New York.

HELP WANTED—MALE

GLASS BLOWER. First class all around glass blower for development work in a large laboratory. Apply giving full particulars to Glassblower, P.O. Box 596 Newark, N. J.

PATENTS FOR SALE

CHEMICALLY compost mixing machine for farmers and florists. Reclaims impoverished land, produces double and assured crops. Used by agricultural department. Foreign patents for sale. Write Harry D. Johnson, 30 Church St. R. 506, New York.

WILL CONSIDER reasonable offer assisting the manufacturer of article No. 725,455, or sell whole or part Patent Right granted April 14, 1903. Address C. Julius Kusche, 524 10th St., Oshkosh, Wis.

FOR SALE United States Patent No. 1,039,772, Oct., 1912, proved merits anti-skid, shock-absorber, anti-friction wheel for vehicles, the twentieth century simplicity (can be purchased outright or singly), state manufacturing rights in all important countries, patented by me, prospects for same will be considered. Note patent sales agencies, save your your stamps. Others write to Inventor, Hawkins-Masters, 77 Edwards St., London, Ontario, Can.

WANTED

WANTED. One first-class architectural draftsman at $5.52 per diem. A competitive examination will be held at the Navy Yard, Boston, Mass., December 23, 1912, for the purpose of filling the above position. For further information address, Commandant, Navy Yard, Boston, Mass.

MISCELLANEOUS

MODEL AND FINE CLOCK TRAIN WORK. Estimates given. Work done by the hour or by contract. Waltham Clock Company, Waltham, Massachusetts.

UNITARIAN LITERATURE SENT FREE upon request. For full particulars please communicate with Mrs. C. P. Seagrave, No. 4 Catalpa Road, Providence, R. I.

IRON, BRASS AND ALUMINUM Castings—Wood and Metal Patterns—Special or experimental machines built—Heavy or light Machine Shop Work—Brass, Nickle and Silver Plating—Estimates furnished. A. P. Broomell, Manufacturer, York, Pennsylvania.

INQUIRY COLUMN

Inquiry No. 9288. Wanted the names and addresses of concerns that can coat steel balls with pure tin one-sixteenth of an inch thick.

Inquiry No. 9289. Wanted substance melting at 225° and hardening when cold without imparting any flavor to tobacco smoke and without emitting any oily or fatty vapor.

Inquiry No. 9290. Wanted name and address of a manufacturer of a patented device which is suitable for making up pay envelopes, namely, to fold up bills and insert them with minor coins in a pay envelope of the usual size.

Inquiry No. 9291. Want to buy machinery for manufacturing wooden tooth picks.

TRADE MARK

BRISTOL'S

REG. U. S. PAT. OFFICE.

Electric Time Recorders or Operation Recorders

are cataloged in new Bulletin No. 138 just off the press. Bulletin No. 139 on Bristol's Mechanical Time Recorders also just printed. Write for Bulletins 138 and 139.

The Bristol Co.

Waterbury, Conn.

Introducing Great Inventions

Some Historical Instances

By William Atherton Du Puy

THE pessimistic inventor who holds that the hand of all the world is against him and that his ideas are so ahead of the times that they may not be appreciated until he is dead and gone, is still abroad in the land. He believes that he has the facts from which to draw a conclusion that he who makes an invention that is revolutionary is to suffer many reverses and to wait long for his reward. There are many cases of record to substantiate this belief. There is, however, a question of their application to the inventor of to-day.

There is the case of Sir Henry Bessemer, for instance, and his difficulty, in inducing the world to use his obvious and revolutionary methods of producing steel. So great was the effect of the Bessemer process upon the steel business that the production in England jumped from 50,000 tons a year, to 4,000,000 tons immediately after its introduction, and so great was the effect of the cheaper methods of refinement upon price that steel declined from $300 a ton to $40 a ton. Yet the only way Bessemer could get his process used, was to put up a factory, manufacture steel and undersell his competitors.

Bessemer went at the problem of improving the manner of making steel deliberately. He wanted a stronger metal for the barrels of big guns. He knew nothing of the business. He began at the bottom and learned the science of it. In the end he made a retort with provision for forcing air in from below. He melted his iron and turned on the air. The whole immediately became a sparkling furnace that burned so hotly and so rapidly that it was impossible to reach the valve which would turn off the air. So hot was the fire that the very fastenings of the retort were nearly melted. The transforming process was, however, completed before the heat had demolished the plant. So was the discovery made.

Yet those people with whom Bessemer contracted for the use of his process failed utterly in getting results and abandoned it. He formed a company of his own, built a plant and began the production of steel. This he sold at a price that the producers under the old process could not meet and still made a fabulous profit. Thus, he proved the value of his patents, and, after many years, brought them into general use and from the royalties he received, he waxed fabulously rich.

C. Francis Jenkins is one of the inventors of that familiar entertainer of the ninety millions, which is now to be seen in every town and hamlet of the nation, the moving picture. For four years, he worked upon the moving picture idea before he finally hit upon the key to the whole situation which made the productions as they are seen to-day actually possible. It all depended upon the size of a hole in a shutter and that which Jenkins made was the right size. Because of this, his machine worked.

Yet, this great invention was a thing which led its maker immediately into unlimited worry and harassment. In the first place he attempted to popularize the moving picture and to put it on as a show as it is now put on in so many thousands of theatres. This proved a herculean task. The moving picture was a thing so novel that there was nothing with which to compare it. The public could not be reached by a word of mouth explanation of it. An advertisement could not be written that would carry home an appreciation of what this thing was. The people could not understand, that it was anything more than a magic lantern machine through which one picture after another was drawn.

The first moving picture show that was ever put on and asked for public patronage was at the Cotton States' Exposition in Atlanta, in 1895. People would not pay admission to the show; so finally the doors were thrown open to the public and they were asked to leave a quarter at the box office after the show if they considered that they had been entertained to that value.

The inventor's second disappointment

To Skid Or Not To Skid

HEAVY CAR TYPE

TOWN CAR TREAD

NEW FISK TIRE

The Fisk Town Car Tread Tire is a positive non-skid tire, furnishing on wet pavements and slippery streets, the protection for which every motorist is looking.

Substantial and effective in appearance, this tire combines the strength, the quality and the exclusive features that are found always in the famous **Heavy Car Type Construction**—the construction that has earned for Fisk Tires their reputation for exceptional mileage and long service.

Write for Particulars of This New Tire

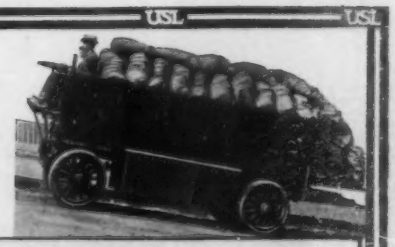
THE FISK RUBBER COMPANY

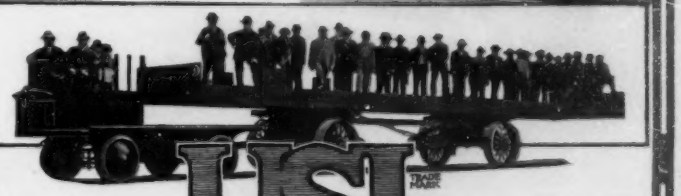
OF N. Y.

Department U CHICOPEE FALLS, MASS.

USL USL USL USL

Not Power, Merely But Sustained Power





Storage USL Battery

THE UNITED STATES LIGHT AND HEATING CO.

In hundreds of important installations throughout the country the U-S-L Storage Battery is proving itself to be the battery that stands up under *continuous*, heavy service. The illustrations above show U-S-L Batteries handling *tons* almost as though they were pounds!

Any battery might do this work when fully charged, but the merit of the U-S-L lies in the fact that its voltage capacity is maintained right up to the end of discharge. "It comes home with lights bright and bells ringing," as one enthusiastic user expresses it.

This U-S-L characteristic is not a common one; for under heavy load or rapid discharge the efficiency of some batteries drops to a point that is really troublesome to the operator. Others become heavy and sluggish after the first few miles of discharge. If you make long runs and it's important that you get there and back without balk or delay; if you encounter hills or sand, or have to contend with traffic congestion, you need the U-S-L Battery to give liveliness, speed, responsiveness and staying qualities to your truck or pleasure car.

Any manufacturer can equip it; *insist* on the U-S-L, either in new purchases or renewing old plates.

U-S-L Service

Insures to users maximum results from all U-S-L equipment. Our service experts operate from stations located in 8 principal cities, where spare parts are always in stock.

Fill out the Coupon and Get Valuable Information

The U. S. Light & Heating Company

General Offices: 30 Church Street, New York

Factory: Niagara Falls, N. Y.

Branch Offices and Service Stations:

Chicago New York Boston Cleveland Buffalo San Francisco Detroit St. Louis

Manufacturers also of the U-S-L Electric Starter and Lighter for Gasoline Automobiles.

The United States Light & Heating Company
30 Church Street, New York

Gentlemen:—Please send me the U-S-L Bulletins checked below:

☐ 1. Power for Electric Vehicles—Pleasure and Commercial.
☐ 2. Electric Light for Railroad Cars.
☐ 3. U-S-L Storage Batteries for Stationary Service.
☐ 4. U-S-L Storage Batteries for Independent Electric Lighting.
☐ 5. U-S-L Starter and Lighter for Automobiles.

(NOTE—With the bulletins will go forward the U-S-L Book illustrating and describing the U-S-L facilities, service and products.) S. A. 11-9-12

Name.....

Street.....

City..... State.....

USL USL

A Suit that all Admire

There is never any question about a good Unfinished Worsted. It is right.

Rich, dignified, prosperous-looking, it takes the graceful lines of good tailoring and holds its appearance through long wear.

It is important, however, to get a good unfinished worsted, and the best way to be certain of quality is to order

A.W.Co
WASHINGTON
1789
UNFINISHED WORSTED
REG. U. S. PAT. OFF.

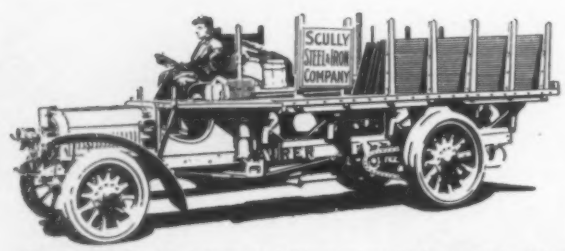
This is one of the thoroughbred style fabrics for men who care, made by the American Woolen Company. It is carefully made, pure worsted and thoroughly dependable. Black or dark blue; London shrunk, 56 to 58 in. wide.

If you prefer a blue serge for Fall and Winter, ask your tailor or clothier to show you Oswego Serge.

You can find Washington 1789 and Oswego Serge at good custom tailors' and in high-grade ready-to-wear suits at the better class of clothiers'. If your clothier or tailor cannot supply you, send check or money order for quantity required (3¼ yards for average man's suit) at $3.25 per yard for Washington 1789 and $3.00 for Oswego Serge, and we shall see that you are supplied through regular channels, as we do not sell at retail.

American Woolen Company
Wm. M. Wood, President.

SELLING AGENCY
American Woolen Company of New York
American Woolen Bldg., 18th to 19th St., on 4th Ave., New York



The Scully Steel and Iron Company of Chicago writes: "Prior to adopting the use of motor-trucks for the handling of our steel products, we were very careful to give this problem deep study, and decided that no mistake would be made in putting the Saurer machines into operation at our plant.

"Continuous operation of our 4½ ton truck during the past six months, averaging better than 40 miles per day shows very low cost of upkeep, and excellent results from both the points of economy and service."

Mack Saurer Hewitt

Proved by 12 years of real use — Proved by 18 years of real use — Proved by 10 years of real use

"Leading gasoline trucks of the world"

What do you *know* about a particular motor-truck—not think, guess, or estimate—what do you *know?*

The Mack, Saurer and Hewitt have been in use for 10 to 18 years—7000 of them, all over the world.

We have history and facts—not mere estimates—of what motor-trucks cost and are earning in such businesses as yours, and this knowledge we are glad to give to any accredited representative of a business.

Capacities: 1, 1½, 2, 3, 4, 5, 6½, 7½, and 10 tons. Bodies to suit every business, built in our own plants.

International Motor Company

General Offices: Broadway and 57th St New York — Works: Allentown Pa; Plainfield N J
Sales and Service Stations: New York, Chicago, Philadelphia, Boston, Cleveland, Cincinnati Buffalo, Baltimore, Newark, Pittsburgh, St Louis, Atlanta, Kansas City Denver, San Francisco, Los Angeles and other large cities
Canadian Sales Agents: The Canadian Fairbanks-Morse Company, Limited, Montreal

was due to the fact, that before the issue of his patents litigation had begun, litigation which has lasted without cessation to this very day and which has every appearance of continuing until the time the patents expire. Franklin Institute of Philadelphia, early extended to Jenkins the Eliot Cresson gold medal in acknowledgment of his accomplishment. This was a great satisfaction to the young inventor. Yet, so harrassing was the litigation as well as the difficulty of popularizing the machine, that he eventually sold it outright. For this invention which has earned tens and probably hundreds of millions, he received $5,500. Despite the smallness of this sum and the far reaching nature of the invention Jenkins says, he has never been sorry of the sale.

Alfred Nobel, the man who has done the mass of the world's work toward the development of commercial explosives and has thereby made modern mining, canal building, railroad building and kindred industries possible, suffered untold discouragements and temporary defeats before he finally attained success. In the end, however, he amassed a huge fortune, $12,000,000 of which he set aside and provided that the income from it should, each year, be distributed in prizes to the men of the world who did most for progress.

Nobel was very delicate in health from birth and his battles in making explosives possible were, from first to last, in the face of physical suffering that would have discouraged any but a man of superb determination. His life was largely spent in Scandinavia and in St. Petersburg. It was sixty years ago, that he first undertook the task of making the transportation and handling of nitro-glycerine comparatively safe. As Bessemer began his experiments with steel that he might develop greater strength in gun barrels, so did Nobel begin his studies of explosives that he might develop a stronger charge for use in them.

Nitro-glycerine, when it comes in contact with the hands, produces intense headaches. Nobel, delicate, nervous and supersensitive, suffered intensely from headaches caused in this way for the twenty-five years that he handled the explosive. Likewise did he constantly run the risk of being blown to pieces by the materials that he handled. The tragedies that resulted from his efforts but which he escaped by accident, show the danger to which he was exposed.

Early in his investigations, he went far toward removing the danger from nitro-glycerine. Over and over again, he demonstrated in his very hands the safety from explosion of his product. Unquestionably his first steps went far toward accomplishing the great feat. Finally, a ship load of his preparation was started for Chile. In mid-ocean it blew up and recorded one of the great tragedies of its time. Because of this explosion all the world turned from his invention and upon him. No one would use his explosive. There was even an effort made to make its transportation anywhere in the world unlawful.

Nobel acknowledged that his problem was not yet worked out and he labored for yet another ten years. The final solution he happened upon by accident. While working in his laboratory, he cut his finger. He sent out for collodion with which to dress the wound. Collodion is made of gun cotton dissolved in some volatile solvent such as ether. The combination is spread on a wound, the ether immediately evaporates and the dressing of gun cotton is left as a sort of artificial skin. After dressing the wound he poured the remaining collodion into some nitro-glycerine with which he was working. The ether evaporated out and the gun cotton remained, converting the whole into a sort of gelatine. He experimented with this accidental product and found it the safest explosive yet developed. It was at about this time, however, that he got his second set-back, for his factory exploded disastrously and so was the industrial world given another scare from which it required another decade to recover. The clamor of the engineering world for an explosive, the desire to wrest treasures from the bosom of the earth, to cut roadways in mountain sides, to link ocean with ocean through the digging of canals, caused a gradual turning to the comparatively safe explosive of Nobel and their ultimate general use.

"All these stories," says Emile Berliner, inventor of a telephone receiver and transmitter and of a talking machine, "are, however, largely of the past." Invention and the inventor have made themselves a position in the world since the days of these tribulations on the part of the man who takes out a patent. I have been an inventor for many years and I know many inventors. I used to hear much complaint from these men because of the difficulty of placing a good idea. I hear these complaints no more.

"Take such a case as that of the telephone. There must needs be some difficulty in introducing it for the idea is so novel, that it cannot be readily grasped. It must also be remembered that the telephone was a very indifferent transmitter of speech for a long time after it came into partial use. The delay in its adoption was very largely due to the fact, that it was not yet perfected and this is true of many inventions that are slow in getting hold. The average invention applies in some given industry. The people who are making big money out of that industry are always anxious for any improved appliance. The man who invents something of actual practical use needs but get in touch with the people who should use it and his reward is almost immediate. This is particularly true of America, where invention has done so much and where rivalry is so intense, that each man is grasping for anything that will give him a small advantage over his rival."

The Arlington Wireless Telegraph Station

WORK on the Naval Wireless Telegraph Station at Arlington, Virginia, is rapidly nearing completion. On October 29th, the apparatus was put to a partial test. The signal N.A.A. of the Arlington Station was repeatedly flashed in the effort to reach Key West, but for some reason it was impossible to reach that station. However, when the receiving apparatus was tested, the operators were able to take messages sent from the Marconi station at Clifden, Ireland, a distance of 2,500 miles. When the Arlington plant is completed, and working under full power, it is confidently expected that communications will be established not only with Key West, but with Panama, San Francisco, and San Diego.

The Use of Aeroplanes in Actual Warfare

NOW that hostilities have broken out between the Balkan States and Turkey, it is interesting to know that both sides have a number of aeroplanes and pilots to man them. A number of monoplanes were used with excellent success by the Italians in the war with Tripoli. On August 24th Lieut. Manzini fell into the Mediterranean and was drowned while reconnoitering in this war. Turkey has a dozen or more officer aviators who have learned to fly in England and in France. These men are pilots of Bristol, Blériot, and R. E. P. monoplanes, and of Farman biplanes. The Servian Army has three aviators and machines of the Blériot type, and the Roumanian and Bulgarian armies also have strong forces of aviators with various types of aeroplanes. There are several good Montenegrin military aviators, and the Greek officers who learned at the Farman school in France have shown themselves to be excellent flyers. The Bulgarian army has six or more Bristol monoplanes, while at the Roumanian army maneuvers the first part of last month, Mr. C. H. Pixton made some excellent demonstration flights with one of these English machines.

Ten Italian and Russian aviators, including Abramovitch (who recently flew from Berlin to St. Petersburg) and Nicolas Popoff were engaged by the Servians and Bulgarians to scout for the allied armies. Both the above-mentioned

Hamburg American
Largest S. S. Co. in the World
Over 400 SHIPS 1,210,000 TONS

Personally Conducted
Cruises
to the
Panama Canal and West Indies
by large "Prinz" steamers of our **Atlas Service**, sailing November 16-30, December 14
25 days $215.00
All expenses included

"Now Is The Time"
to visit the
Panama Canal
West Indies, Bermuda and the Spanish Main
We have increased our service this season to
8 Cruises
by the **S. S. Moltke**, January 4, 23; February 25, March 29, 1913, and **S. S. Victoria Luise**, January 15, February 8, March 11, April 10, 1913.

2 Cruises
from
New Orleans
January 23 and February 10
by well known Steamships

Comprehensive Tour of the
Orient
from New York, Jan. 28, 1913, by **S. S. Cincinnati** (17,000 Tons), an 80-day cruise, $325 and up, including all landing and embarking expenses.

Delightful Cruise
Around the World
Sailing from San Francisco Feb. 6, 1913, by **S. S. Cleveland** (17,000 Tons), 110 days, $650 up, including all necessary expenses aboard and ashore.

Write for booklet, stating cruise

Hamburg-American Line
41-45 Broadway, New York
Pittsburgh Philadelphia
Boston Chicago
San Francisco
St. Louis

Russians were pilots of Wright biplanes. The latter, who was the pioneer Russian aviator and the chief instructor of the Russian army, made several excellent scouting flights over the Turkish lines in the vicinity of Adrianople. According to press reports, on the 31st ultimo, while soaring over this besieged city, his machine was struck by a schrapnel shell and Popoff fell to his death. A Farman biplane was used by the Greeks for scouting before the invasion of Turkey was decided upon. The country was flown over within a radius of 50 miles, and when no Turkish troops were found, the invasion was immediately begun.

Notes for Inventors

Twelve Eye-glass Patents.—The patents issued October 1st, 1912, include twelve patents numbered from 1,040,094 to 1,040,105, inclusive, to Leo F. Adt, of Albany, N. Y., for eye-glasses or eye-glass mountings.

Dries by the Aid of Magnetic Field.—In patent No. 1,040,486 William H. Allen, of Cleveland, Ohio, presents a method of desiccating an organic substance by subjecting the substance to the action of a magnetic field in a compartment and circulating cool dry air through such compartment.

Combines a Bottle and Drinking Cup.—Fortunatus F. Syracuse, of New York city, in patent No. 1,039,843 shows a cup in goblet form with a hollow standard communicating with the chamber of the cup and in the chamber is fitted, removably, a flexible and elastic bag whose neck is secured in the standard of the cup, the neck being sealed and the body of the bag lying normally within the chamber of the cup.

A Fessenden High-frequency Electrical Conductor.—Reginald A. Fessenden, Brant Rock, Mass., assignor to National Electric Signaling Company, of Pittsburgh, in patent No. 1,039,717 presents a coil for high-frequency currents in which a strip conductor formed of a number of wires is wound edgewise and the position of the wires in the strip are varied in spiral fashion and in opposite senses with the length of the strip and are also plaited.

A New Toy Whistle.—A toy whistle having two whistles spaced apart like the ordinary tin, penny whistle and connected by a tubular bellows to retain the air and a spring within the bellows to force the whistles normally apart so that by compressing and releasing the end whistles rapidly, a practically continuous whistling sound will be produced, is disclosed in patent No. 1,039,840, issued to Victor Silva Sacavem of New York city.

Another Everflowing Bottle.—An inclined bottle mounted on standards with that nearest the uptilted bottom of the bottle hollow and extended into the bottle and curving downwardly at its discharge end to prevent splashing in the bottle is shown in patent No. 1,041,149 to Chas. W. Nichols of Rahway, N. J. The bottle discharges into a small tank and a pump circulates the water from the tank through the hollow standard into the bottle from which it pours into the tank.

Double Compartment Condiment Holder.—Patent No. 1,039,729, granted to Jacob Gottlieb, of New York city, covers a condiment holder with a partition to form compartments and a perforated top, while between the top and the compartments there is provided an inclined wall which is revolubly mounted to revolve horizontally so that it can be set to shut off one or the other of the compartments and to convey the substance of the other compartment to the sifting top so that salt or pepper can be discharged at will.

Novel Arrangement of Automobile Seats.—Franklin J. Morgan, of Chicago, shows in patent No. 1,039,780, the arrangement in connection with a steering mechanism at one side of the body of an automobile of three seats disposed in a single row and each comprising a complete seat and back. One of the end seats is located immediately in rear of the steering mechanism and the middle seat is abruptly offset in rear of the line of the adjoining end seats

Franklin

Franklin Little Six—Thirty, Touring

A car of unusual beauty with all the smoothness, silence and flexibility of six-cylinder construction. Light weight, economical to run, easy riding, fast over the road. Exceptionally able with ample reserve power for every requirement. Five-passenger Touring car; Two-passenger Victoria-phaeton. Price $2,800.

As a Man of Affairs you will be particularly interested in knowing why the Franklin has stuck so consistently to its distinctive principles of construction—direct air cooling, light weight, full-elliptic springs, wood frame and large tires.

We have done so because it has been absolutely proven, under all conditions of service by thousands of Franklin owners for eleven years, that these principles are directly responsible for the unusual results obtained from Franklin cars.

For example: Franklin cars use less gasoline, averaging from 20 per cent. to 35 per cent. greater mileage per gallon. This is the result of the exceptional efficiency of the Franklin direct air cooled motor. Franklin cars average from 400 to 600 miles per gallon of oil without smoke. This is due to the Franklin re-circulating oiling system. Franklin cars use fewer tires. This is the result of light weight on large tires, and because the tires are not pounded by rigid, unyielding construction. Franklin cars travel faster in the long run, ride easier and last longer because of the shock-absorbing properties of the full-elliptic springs, resilient wood frame and flexible drive system.

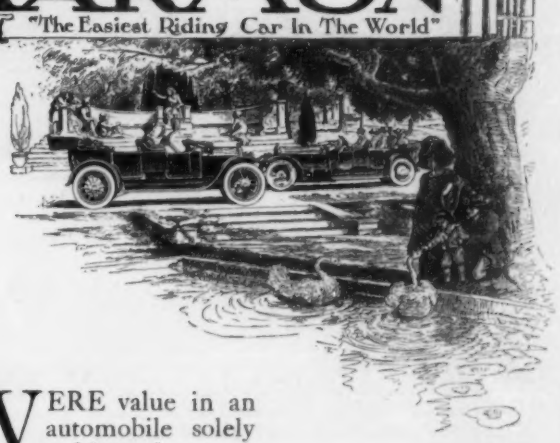
These principles are explained more fully and Franklin construction is analyzed point by point in a simple, non-technical way in a book recently written by our engineers, entitled "An Analysis of Franklin Motor Car Construction." We will be glad to send this book, together with our catalogue, to any one who is seriously considering the purchase of a car of Franklin quality.

THE FRANKLIN LINE

D Touring, 6 cylinder, 18 H.P., 5 passengers $3500
D Torpedo-phaeton, 6 cylinder, 18 H.P., 4 passengers $3500
H Touring, 6 cylinder 38 H.P., 7 passengers $3750
H Limousine, 6 cylinder 38 H.P., 7 passengers $4750
M Little Six, Thirty, Touring, 5 passengers $2800
M Little Six, Thirty, Victoria-phaeton, 2 passengers $2800
G Touring, 4 cylinder, 25 H.P., 5 passengers $2000
G Runabout, 4 cylinder, 18 H.P., 2 passengers $1650

FRANKLIN AUTOMOBILE COMPANY
11 Franklin Square Syracuse N Y

MARMON
"The Easiest Riding Car In The World"



WERE value in an automobile solely a thing of appearance, or of luxury, or of convenience, or of service, or of economy, or of durability—the Marmon might be comparable to many other cars. But Marmon prestige is the result of the highest development of all these important factors. Marmon reputation—Marmon records—Marmon cars in service—all go to prove Marmon superiority.

Detailed information given on request

Nordyke & Marmon Co.
(Established 1851)
Indianapolis, Indiana
Sixty Years of Successful Manufacturing

The Marmon "32"
32-40 h. p. 120-inch wheelbase electric starting and lighting, left-hand drive, center control, nickel trimmings with newest body types to meet every requirement and corresponding equipment—$2 850 to $4,100

The Marmon Six
48-80 h. p. 145-inch wheelbase electric starting and lighting left-hand drive, center control, nickel trimmings, with body types to meet every requirement and corresponding equipment—$5 000 to $6 150.

Waltham *Premier Maximus* Watch

with the Kew *Class A* Certificate

in this *casquet de luxe*

is a treasure which marks the zenith of splendid giving. It is the utmost possible in marvelous accuracy, honored by authority, and dressed in princely magnificence. The Premier Maximus in its 18 carat gold case is the finest and most wonderful watch made at Waltham. There can be no higher praise.

When this watch is accompanied by the Kew Class A Certificate it means that the Kew Observatory of England (the most famous in all the world) has scientifically tested and tried this particular watch and guaranteed it as of maximum accuracy. Such a certificate means that the instrument is more than a fine watch: the stars in their courses are scarcely more regular.

The Sterling Silver *casquet de luxe* is a fitting gift case for such an instrument. At the top may be engraved the owner's name and the occasion of the gift if desired. And it may be used as a handsome ornament or jewel case.

The price complete is Four Hundred Dollars.

It sometimes happens that an individual or a group desires to make a gift which shall express a vast regard or the deepest affection;—and the world's best is not too good. Here is the response.

We think you would be interested to know more of this wonderful watch, and the unique Kew Observatory (it is an extraordinary place). We will gladly send you without charge a booklet about the watch and the place. Please mention "The Gift for a Prince."

WALTHAM WATCH COMPANY, - - Waltham, Mass.

JUST PUBLISHED

SCIENTIFIC AMERICAN REFERENCE BOOK
EDITION OF 1913

It contains 608 pages and 1000 illustrations, is substantially bound in cloth and the cover carries a special design printed in three colors

Albert A. Hopkins
Compiler and Editor for Part I. STATISTICAL INFORMATION. Editor of Cyclopedia of Formulas, Handbook of Travel, Etc. Member of the American Statistical Association.

A. Russell Bond
Compiler and Editor for Part II. SCIENTIFIC INFORMATION. Editor of Handyman's Workshop and Laboratory.

The editorial staff of the Scientific American receives annually over fifteen thousand inquiries, covering a wide range of topics—no field of human achievement or natural phenomena is neglected. The information sought for in many cases cannot be readily found in text books or works of reference. In order to supply this knowledge in concrete and usable form, two of the Editors of the Scientific American have, with the assistance of trained statisticians, produced a *remarkable Reference Book*, containing over seventy-five thousand facts, and illustrated by one thousand engravings, for which the entire world has been scoured. Immense masses of government material have been digested with painstaking care with the collaboration of government officials of the highest rank, including cabinet officers, and assisted by competent professors of world-wide reputation.

Owing to the printing of an edition of 10,000 copies, we are enabled to offer this book at a merely nominal price. The purchase of the book is the *only adequate* way to judge of its merits. An elaborate circular, showing specimens of illustrations, together with four full-size sample pages, will be sent on request.

Part I.
STATISTICAL INFORMATION.
Chapter I. POPULATION AND SOCIAL STATISTICS.
Chapter II. FARMS, FOODS AND FORESTS.
Chapter III. MINES AND QUARRIES.
Chapter IV. MANUFACTURES.
Chapter V. COMMERCE.
Chapter VI. MERCHANT MARINE.
Chapter VII. RAILROADS.
Chapter VIII. THE PANAMA CANAL.
Chapter IX. TELEGRAPHS AND CABLES.
Chapter X. WIRELESS TELEGRAPHY.
Chapter XI. TELEPHONE STATISTICS OF THE WORLD.
Chapter XII. POST OFFICE AFFAIRS.
Chapter XIII. PATENTS, TRADEMARKS AND COPYRIGHTS.
Chapter XIV. ARMIES OF THE WORLD.
Chapter XV. NAVIES OF THE WORLD.
Chapter XVI. AVIATION.

Part II.
SCIENTIFIC INFORMATION.
Chapter I. CHEMISTRY.
Chapter II. ASTRONOMY AND TIME.
Chapter III. METEOROLOGY.
Chapter IV. MACHINE ELEMENTS AND MECHANICAL MOVEMENTS.
Chapter V. GEOMETRICAL CONSTRUCTIONS.
Chapter VI. WEIGHTS AND MEASURES.

Net Price $1.50 Postpaid

Send for large prospectus and specimen pages.

MUNN & CO., Inc., PUBLISHERS 361 BROADWAY, NEW YORK CITY

and its back is correspondingly offset. The occupant of the middle seat is so situated that he will not cause any interference with the steering operations.

Supplies Air to Firemen.—A patent, No. 1,040,311, has been issued to James D. Halloran of New York, N. Y., for an air-supply device in which there is combined with a fire hose a nozzle and an air-suction device connected with the nozzle at the discharge end thereof for drawing in air by the passage of the water through the nozzle, a main air-supply pipe being connected with the suction device and tapping means being connected with the main air-supply pipe with distributing devices connected with the tapping means so that the air may be distributed to the firemen for breathing purposes.

Legal Notes

Difference Between an Assignment and an Option to Purchase.—Assistant Commissioner Tennant in the case of Newman has decided that while the assignee of the entire interest in an application for patent may be permitted to prosecute such application for patent to the exclusion of the inventor, the Patent Office cannot recognize a party having only an option to purchase.

United States Cancels Three Patents.—By a decree of the United States District Court for the Eastern District of Pennsylvania, entered July 18th, 1912, in the case of the United States v. John Allen Heany, patents numbered 839,585, 842,546 and 872,936 were canceled and a copy of the decree has been recorded in the assignment records of the United States Patent Office. Heany was involved in fraudulent transactions relating to the patents.

Patentability and the Dissolution of Interference.—In the case of Thompson v. Kiely, both parties were applicants for patent and were put in interference and it was held that the fact that each of them moved to dissolve the interference on the ground that the issue is not patentable, does not warrant the dissolution of the interference if the examiner is of the opinion that the issue is patentable, and Assistant Commissioner Tennant said that if the parties do not wish to contest the question of priority they have a remedy by simultaneously filing an abandonment of the invention when the proper action will be a dissolution of the interference.

Trade-marks in China.—A dispatch from Peking states that the Government has under consideration a telegram received from the Chinese Chamber of Commerce in Shanghai requesting the promulgation of a uniform system of registration of trade-marks. W. Roderick Dorsey, the Vice-Consul at Shanghai, in summarizing the present status of trade-mark protection in China, calls attention to the fact that although the commercial treaty between the United States and China of 1903 contemplated protection of trade-marks, patents and copyrights, to citizens and subjects of those countries, no patent laws have as yet been enacted and no Patent Office has as yet been established in China. Provisional registration bureaus for trade-marks have been opened at the Shanghai and Tientsin offices of the Chinese maritime customs where owners of such rights, either personally or by their agents, are invited to register through their consuls, and patents and copyrights are also received for registration. A registration is first effected in the consulate of the country of the applicant and is then sent on to the Commissioner of Customs for registration in the provisional bureau. The result is merely a provisional registration giving tangible evidence of priority of claim of ownership to be considered when trade-mark, patent, and copyright laws come into effect in China and application is made for actual registration. While the protection afforded by this practice is somewhat limited as explained in detail in the *Daily Consular and Trade Report* of the Department of Commerce for July 30th, 1912, it appears to be the only protection offered for this class of commercial property in the Chinese Empire.

Get this Pen Knife Sharpener FREE

and forget the annoyance of dull pocket knives, office erasers, etc. It's a genuine Pike India Stone, one of the famous

PIKE SHARPENING STONES

"The only line that includes every sharpening substance natural or artificial—each the best for some sharpening need."

Pike India is the only stone in existence with crystals of sufficient hardness, toughness, and sharpness to quickly cut the hardest tool steel without grooving. No stone which cuts so fast wears down so slowly—hence its economy. Dropping it won't break it, and if properly oiled it will not glaze. Made in various shapes and sizes and in coarse, medium and fine grits. The best shape for all general tool sharpening about the shop and home is the Pike India Combination Oilstone (one side coarse, the other fine). Size 7 x 2 x 1 and price $1.00 at your hardware dealer's.

Let us mail you this Pike India Pen Knife Sharpener. Merely send your dealer's name and 4 cents for packing and mailing. We'll include "How to Sharpen"—greatest little book ever written on sharpening and how to select and care for oilstones. You'll be pleased. Write today

PIKE MANUFACTURING CO.
106 Main St. PIKE, N. H.

PIKE INDIA

VENUS PERFECT PENCILS

Free Sample

Prove for yourself Venus Pencils are best. Write for Free Sample. Ask for soft, medium or hard.

VENUS PERFECT PENCILS
WRITE SMOOTHEST
WEAR LONGEST
ERASE CLEANEST

17 Black gradations and 2 Copying. Absolutely guaranteed. WRITE

AMERICAN LEAD PENCIL CO.
217 FIFTH AVE. NEW YORK.

YOUR CUE

For the Best Winter Climate, Hotels, Outdoor Sports, Society, go to Resorts of the

CAROLINAS FLORIDA CUBA

The Best and Shortest Way is the

SEABOARD AIR LINE RY.

Ask about our Panama Service through Florida and Havana

Through Service also to
ATLANTA BIRMINGHAM MEMPHIS

Get Booklets, Schedules, Etc.
W. E. CONKLYN, G. E. P. A.
1184 Broadway New York City

HELHETOIL LUBRICATES ANYTHING SEND FOR SAMPLE FREE
118-124 North Clinton St.
CHESLYN & CO. CHICAGO U.S.A.

Learn to Stuff Birds and Animals. A delightful art, easily learned at home. **Big Profits.** Save your trophies. Decorate your home. We teach men, women, boys by mail. Write for Free Book today. **N.W. School of Taxidermy,** 4058 Elwood Bldg., Omaha, Neb.

"Throw Away Your Blue Prints?" "Never!"

Of all the annoying, out-of-place, messy and general unbusiness-like proceedings the filing of valuable Blue Prints, drawings and photographs is perhaps the worst.

A "Y and E" Flat File Cabinet is so accurately and "experience wise" constructed that it will hold upwards of 1000 prints. Inserted in large manila pockets suspended from wooden strips and by referring to the index—on a line with the eye—can be gotten out and spread on the top of the Cabinet which raised becomes a draughting table.

Send for booklet "The Proper Place."

"Yawman and Erbe Mfg. Co."

1148 St. Paul Street, Rochester, N. Y.
In Canada, the Office Specialty Mfg. Co. Toronto
World's Largest Makers of Filing Equipment and Supplies

Pyrene TRADE MARK FIRE EXTINGUISHER

PYRENE has fully made good

Erie Traction Company
THE EDINBORO ROUTE
Erie, Penna.

Sept. 13, 1912.

Pyrene Sales Co.,
Pittsburgh, Pa.

Gentlemen:—

Reporting on Pyrene Fire Extinguishers, one dozen of which we purchased from you in December 1911 and which we have had in service on our cars since that time, we are pleased to advise that these extinguishers have found frequent use in our service, have never failed to work satisfactorily, are liked by trainmen and have given results which have fully made good the representations of your company and exceeded the expectations of ourselves.

Within the last thirty days, the use of one of these extinguishers checked and prevented a serious fire in our package freight car. The fire started in a shipment of inflammable goods and had our trainmen not had an extinguisher at hand, they would have been unable to check fire until it had gained serious headway.

In placing another order with you at this time for additional extinguishers, we volunteer the above report which we trust will be of service to you and which we consider so well deserved.

Yours very truly,
Erie Traction Company
Chas. M. Hatch
Manager.

CMH/EM

More than a million people a day ride in the New York Subway. Figures show that 1,179,512 were carried in a single day. They are protected from fire by 5,877 Pyrene Fire Extinguishers.

Every place of business, dwelling or automobile and all electrical equipment should be protected from fire by Pyrene Fire Extinguishers, the most efficient known.

Size 3 inches in Diameter, 14 inches Long. Weight 5 lbs. filled.

Good until it is used. Readily filled after using. No cost of maintenance.

Let us send you free booklets.

PYRENE MFG. CO.
1358 Broadway, New York City

The Greatest Engineering Work of All Times

(*Concluded from page 390.*)

feet square at the base and 400 feet in height—a mass in other words, which, as our illustration shows, would entirely cover in and shut out of sight, the new Pennsylvania Terminal at New York and tower several hundred feet above the lofty roof of the main hall.

The Chinese Wall has always been considered to be a fairly big job of construction. It is fifteen hundred miles in length, and would reach from San Francisco to St. Louis. But the material taken out of the canal prism would build a wall 2,500 miles in length and of the same average thickness and height as the Chinese Wall, the structure reaching entirely across the United States. Again, the canal from shore to shore is only forty miles long, or fifty miles between the deep-water contours on each ocean. But the same amount of excavation would dig a canal 55 feet wide and 10 feet deep entirely across the United States.

Lastly, if all the excavated material were loaded onto flat cars it would form a dirt train sufficient to reach over four times around the globe; moreover the bore holes driven for blasting out this material, if placed end to end, would pass entirely through the earth.

The Sanitation of the Canal Zone

(*Concluded from page 393.*)

residence, in the tropics for colonies of northern white races, without any appreciable ill-effect on either their physique or mentality. But their remaining in good health is conditional upon properly conducted measures of sanitary prophylaxis. The question is not "Can a white colony live and labor in the tropics?" but rather, "Can a white colony afford to undertake the sanitary work necessary to make it possible for its members to live in health?" The last question can only be answered by a careful study of the conditions in a given locality. From the experience gained in Panama, in Cuba and in the Philippines, we believe that in most places the cost of sanitation can be made to fall well within the boundaries of economic feasibility, if directed by a competent sanitarian. Whether or not the Caucasian race can permanently inhabit the tropics, continue a healthy vigorous race and maintain a high degree of culture is a question I am not prepared to discuss. That under proper conditions Caucasians can live long enough in the tropics to accomplish a prodigious task of engineering, such as the Panama Canal, and do it without any great sacrifice either in lives or in health, has been demonstrated. To-day healthy and vigorous American men work with snap and vim under the hot sun of Panama, play baseball, tennis and other games. American women do housework, play tennis, ride horseback and dance enthusiastically, and chubby little American children, born and raised in Panama, play on the lawns and attend American schools. We have learned how to live in the tropics.

The Electrification of the Panama Canal

(*Concluded from page 397.*)

for a considerable period will suddenly be called upon to operate and must perform its function absolutely without fail. To insure this the best of machinery and the best methods of construction have been employed. Very special attention has been given to the conditions of humidity on the Isthmus and a suitable insulation for electrical machines to be used in such a place has been developed, after a study involving much expenditure of time and money. The prevention of corrosion of the metallic parts has also been given especial attention.

For operating the rising-stem gate valves, 116 50-horse-power motors will be employed. The function of these valves is to regulate the flow of water into and out of the locks from the upper level through the main culverts in the side and

Chief Croker and Chief Archibald

OF NEW YORK
Pres't of the Croker Nat'l Fire Prevention and Engineering Co.

OF CINCINNATI

Three Great Fire Fighters
CHIEF CROKER (right), CHIEF ARCHIBALD (left) and THE SAFE-CABINET. (The falling of the shelves was due to the expansion of the walls.)

after witnessing actual fire tests of steel filing cabinets unreservedly declared that the best of them all is

THE SAFE-CABINET

Ex-Fire-Chief Croker says:

"Wonderful! The test was very severe and it shows THE SAFE-CABINET to be proof against fire. The way it came through was wonderful."

Ex-Fire-Chief Archibald says:

"That settles the question. THE SAFE-CABINET is vastly superior to all other filing cabinets of which I have any knowledge."

Six of the best known double wall steel filing cabinets were successively placed in a specially constructed furnace. The most accurate scientific instruments for registering the external and internal temperature were used. The tests were conducted under the supervision of Prof. E. S. Merriam, of Marietta College, who personally checked all instruments and readings.

THE SAFE-CABINET
(1913 Model)

was in the fire for 49 minutes, thirty of which averaged in excess of 1700 degrees Fahrenheit (estimated to be actual severe conflagration heat). The internal temperature at no time exceeded 290 degrees F. At the end of this ordeal a fire hose was turned on its white-hot doors and outer walls. THE SAFE-CABINET was then opened and its contents were found to be uninjured. Papers and currency, which had been placed in the cabinet before the test, were taken out in perfect condition.

The contents of the five cabinets of other makes were in process of destruction at the end of periods ranging from 6 to 17 minutes, and in every case the destruction was completed before the completion of the test. Not one of the five was subjected to the fire for more than 28 minutes, some not more than 13 minutes.

We have issued a complete report of these tests, omitting only the names of the competing cabinets. The accuracy of this report is a matter of legal affidavit. Write for it. It is free.

THE SAFE-CABINET COMPANY

Dept. Y. **Agencies in most cities. Look in your telephone directory.** **Marietta, Ohio**

ELECTRENE

One Quart and One and One-half Quart Sizes

An Improved
Safe Handy Efficient
Fire Extinguisher

For Electrical Use
Electrene is a non-conductor, especially suitable for power stations and high-class machinery generally.

For Garages and Automobiles
Electrene has no equal for putting out fires from gasoline.

For General Shop and Home Use
No pumping at the fires; no training necessary.

For Shipping and Motor Boats
Electrene is invaluable by reason of its entire reliability under all conditions.

Thoroughly Made—Fully Tested

Standard of New York and Washington Fire Departments—Write for Pamphlet

SIMPLY TURN THIS NOZZLE
NO PUMPING AT THE FIRE

Electrene Company
Whitehall Building, New York City

Winter Weather is
Tirenew Weather
Mud, Snow, Slush—
this means that your tires are practically running in water—moisture is constantly soaking into the tire fabric through the cuts in the outside rubber coating, rotting the tire, shortening its life and inviting blow-outs and rim-cuts.
TRADE MARK
TIRENEW
Narco Product
Narco Product
Waterproofs and Protects
A liquid, unvulcanized rubber compound with a base of pure gum; thoroughly waterproofs the fabric, protects and preserves the whole tire—the liquid tire insurance against oil, moisture and air. Makes tires look like new.
Tirenew Before Storing—
don't store your car without first Tirenewing the tires INSIDE AND OUT—it will prevent storage deterioration. Then when you DO put the car in commission again your tires will be in shape to resist oil and moisture.
Many Garages do Tirenewing—ask yours.
A Trial Can—Send 25c in stamps for a trial can—contains enough to Tirenew one tire. Give dealer's name and state which color you want—tire gray or pure white.
NATIONAL RUBBER CO., 4405 Papin Street, St. Louis, Mo.
Buy by the Box—Buy a box of ½-gallons—convenient and economical. If your dealer can't supply you we will.
TIRENEW

Find Out for Yourself

MANY men fail in life because they fail to investigate their own opportunities.

Be a *success*. Let *no* opportunity slip by.

Don't let the opportunity pass to investigate the United States Navy—either as a four years' course of training or as a life business.

Find out to *your own satisfaction* about Navy pay, hours, promotion. See the actual effects of the healthy life, systematic bodily exercise, travel and fine companionship, on the Navy men themselves.

Learn about the Navy's 50 different trades and your chance to practice or learn one of them.

Get real figures showing how the increasing pay mounts up, and how you can have a good snug sum to retire on.

Get all these facts *first hand* from the officers in charge of the Navy Recruiting Station in your vicinity. You'll enjoy meeting and knowing these fine men.

If you are between 17 and 25 years of age, write us today for address of nearest Recruiting Station, also a copy of the fascinating free book—"The Making of a Man-o'-Warsman." It tells in simple language and fine colored pictures all about daily life in the Navy.

Whether you intend joining or not, you'll enjoy this book. Have your parents read it, too. Write for it today to

Bureau of Navigation, Box 39 Navy Department, Washington, D. C.

UNITED STATES NAVY

center walls. A rising valve stem passes vertically through a stuffing box in a horizontal water-tight bulkhead, in this way closing the bottom of the machinery chamber 32 feet below the high level of the water in the lock. The upper end of the valve stem is carried by a crosshead actuated by two vertical, revolving, non-rising screws, the latter being driven by a 3-phase induction motor by means of a reducing gear from the horizontal shaft. A solenoid brake on the motor allows it to be brought to rest immediately should the line current be interrupted. Arrangements are made so that the machinery may all be operated locally or by remote control, and auxiliary hand apparatus is also provided for closing the gate. The current is cut off at the proper point in the travel of the crosshead by means of a limit switch.

To operate the cylindrical valves, 7½ horse-power motors will be used. There will be 120 of these valves, 20 in each of the single locks. These valves control the flow of water from the culvert in the center wall and in the smaller lateral culverts beneath the floors of the lock from which it rises through the walls into the lock chambers.

For the operation of the lock gates, of which there are 46 pairs, 27 horse-power motors will be required, one to each leaf, 46 7½-horse-power motors will also be required for the miter-forcing machines which force the gates to come together perfectly and then lock them when they are in this position.

For the operation of the chain fenders, pumps will be used and 48 70-horse-power motors will be used for driving these. In order to prevent a ship from ramming the gates in case of accident, these fender chains are stretched across the lock chambers in front of certain miter gates. When not in use these chains are lowered into a well in the floor of the lock chamber. An hydraulic pressure and plunger mechanism is used for lifting and lowering the chains and the water supply for operating this mechanism is obtained by means of motor driven pumps.

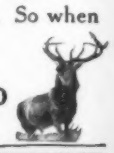
In case of damage to the gates or should it be desirable to make repairs, six emergency dams will be erected to check the flow of water through the locks under these conditions. These dams will be placed in pairs in the approaches to the upper locks about 200 feet above the upper guard gates, each one closing the approach to one of the single locks. The turning and wedging of the dam and the lowering of the wicket girders and gates will require four movements. The machines of this operation will be driven by electric motors with hand power possible for emergency use. Two 150 horse-power motors for turning the bridge and a limit switch to prevent operation beyond an arc of 90 degrees, will be located in the operator's house at the end of the short arm on the emergency dam. The wedges will be operated by a 25 horse-power motor, and the bridge will be firmly held in place when it is at rest across the channel or lock wall. A hoisting drum driven by a 25 horse-power motor with its equipment of limit switch will be used for raising and lowering each of the six wicket girders of the dam. The gates on the girders will also be lowered into place by the same means, gravity assisting the electric power. There will, therefore, also be six gate hoisting machines for each dam, a 25 horse-power motor being used with each.

An electrically operated remote control from the center point will be used in connection with the various gates, valves, fender chains, etc., of the locks. There will be one such central control station for each of the series of locks at Gatun, Pedro Miguel and Miraflores. The starting panels which will be placed in each machinery chamber, will be equipped with contactors by means of which current will be applied to the motors. These starting panels will, in turn, be controlled from the central control stations at the lock sites. Some of the machinery chambers will be 2,700 feet from the point of control. Ninety per cent of them will

His Work Done

WHEN the fireman's work is done then comes the adjustment of the damage and the call on the fire insurance company to pay for the loss.

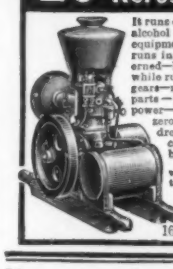
The **Hartford Fire Insurance Company** has in its hundred years and more of life, paid the enormous sum of 150 millions of dollars to make good losses by fire. This is the largest amount paid by any fire insurance company, but the **Hartford** is to-day stronger than at any time in its history. So when you need fire insurance



INSIST on the HARTFORD

Agents Everywhere

20 Reasons Why You Should Investigate the SANDOW Kerosene Stationary ENGINE



It runs on kerosene (coal oil), gasoline, alcohol or distillate without change of equipment—starts without cranking—runs in either direction—throttle governed—hopper cooled—speed controlled while running—no cams—no valves—no gears—no sprockets—only three moving parts—portable—light weight—great power—starts easily at 40 degrees below zero—complete, ready to run—children operate them—5-year iron-clad guarantee—15-day money-back trial. Sizes 2 to 20 H. P. Send a postal today for free catalog, which shows how Sandow will be useful to you. Our special advertising proposition saves you one-half cost of first engine sold in your county. (167)

Detroit Motor Car Supply Co.
162 Canton Ave., Detroit, Mich.

If you can't have the best of everything, at least you can have the best of Pencils—

L. & C. Hardtmuth's

"KOH-I-NOOR"

"Koh-i-noor" Pencils supplied by high-class stationers, dealers in drawing materials, artists' supplies, &c.—Illustrated list on application to

L. & C. HARDTMUTH,
34, East 23rd Street, New York;
and Koh-i-noor House, London, England.

Jaeger Sanitary Goods

Sanitary Underwear

Chills and colds are often the cause of serious disease—or worse. Chills and colds are practically eliminated by the use of Jaeger Pure Wool Underwear. Seven weights to choose from. Recommended by leading physicians everywhere.

Samples and explanatory booklet on application.

Dr. Jaeger's S.W.S.Co.'s Own Stores
New York: 306 Fifth Ave., 22 Maiden Lane
Brooklyn: 504 Fulton St. Boston: 324 Boylston St.
Phila.: 1516 Chestnut St. Chicago: 126 N. State St.
Agents in all Principal Cities

A section of the roof where Lowe Brothers products are exposed to sun, rain, snow, frost, soot, dirt and fumes of city smoke for years. The panels are then preserved as a guide to attaining the very highest efficiency in all Lowe Brothers products.

This is the way we test Paints for you

There is no guesswork in the making of High Standard paints. The ingredients are selected with scientific accuracy and are mixed and ground by the best paint-making machines. *But that is not all.* In order to *prove* that every one of the 54 tints and shades of

Lowe Brothers High Standard Liquid Paint

—the Paint of Performance

will give most satisfaction on *your building*, they are subjected to the severe tests described above. These panels are painted just as you would paint your house. The weather proofing qualities of the paint are fully assured before you buy it—and no High Standard product is offered to you until it has stood these tests.

Mellotone

YOUR INTERIOR WALLS

Mellotone is the most beautiful of all flat wall finishes. It is washable, durable and sanitary, and the colors, "soft as the rainbow tints," harmonize with any decoration. Send for color cards.

Let us send you our books, "**Harmony in Color,**" and "**Homes Attractive from Gate to Garret,**" (both free.) "**Good Homes by Good Architects**" (25 cents in stamps.)

The LOWE BROTHERS CO.
474 E. Third St. Dayton, Ohio
Boston New York
Chicago Kansas City
The Lowe Brothers, Ltd., Toronto, Can.

"THE RIVALS." From the Painting by C. E. Johnson.

"Let's Play Just One More Game!"

Cares and worries take wing, the flight of time is forgotten, when congenial companions match wits and skill in a lively game of *home billiards.*

A first-class Billiard Table is a successful rival to the Theatre, the Club and the various forms of amusement outside of the wholesome influences of *home.*

It is a veritable "Home Magnet," with inexhaustible resources of entertainment for young and old.

Brunswick Home Billiard Tables

Our beautiful book accurately describes and illustrates in **full colors** the many styles of Billiard and Pocket-Billiard Tables designed for the home.

Each is a genuine "BRUNSWICK"—made by the concern whose tables are used EXCLUSIVELY by the billiard experts of the world. Perfect playing qualities guaranteed.

Brunswick "Baby Grand"

Home Billiard or Pocket-Billiard Table

Made of finest mahogany with inlaid design, is a superb specimen of the cabinetmaker's art.

Our unique "Convertible" Billiard Tables can be instantly turned into luxurious Davenports or handsome Dining or Library Tables. No "extra room" needed.

Over a Year to Pay

The prices on these Brunswick Home Billiard Tables are very attractive and you can pay cash or spread the small monthly payments over an entire year, just as you prefer. **Full Playing Equipment Free with each style of table.** Your investment in a "BRUNSWICK" will pay big daily dividends in health and happiness for the family circle. Write for the booklet, "Billiards—The Home Magnet." (50)

The Brunswick-Balke-Collender Co.
Dept. A. S., 324-328 S. Wabash Avenue, Chicago

be within 2,000 feet, and 50 per cent of the total within 1,200 feet. The switchboards which are placed in the central control houses are being made to resemble very closely the plan view of the locks.

The movement of each machine is shown visually to the operator by an indicator mounted on a board which has the same relative location and is constructed to represent it in appearance and travel. The motion of the machine itself is followed by these indicators in practically synchronism, and with a very high degree of accuracy. In order to further assist the operator and to prevent mistakes, a mechanical interlocking of the individual switches controlling the various motor and contactor panels is used, it being thus possible to operate in correct sequence only the various gate machines, fender chains, etc.

The use of electricity in hauling the vessels through the locks by means of electric locomotives is one of the most important uses of electricity on the canal. Forty locomotives will be required and four will be used with each ship: two towing the ships, one on each side of the lock and two locomotives attached to the stern, one on each side for steadying the ship in its passage. The locomotives will have a drawbar pull of 3,400 pounds, and will tow the vessels at a rate of 2 miles per hour, and will return at a rate of 5 miles per hour. All of the towing tracks will have a center rack throughout, and a pinion in mesh with this rack will always be used by the locomotives while towing.

In addition to the above-mentioned uses of electricity, we may name applications for lighting, telegraph system, fire alarm system, system for mining batteries, and, undoubtedly in the extensive fortifications which will be erected; other fields will be found for its application. The use of electricity in connection with the canal has been studied most thoroughly in every detail by the engineers connected with this work, and with reliability of operation as the factor of prime importance. The whole installation will be a monument alike to the development of electrical art and to the care and skill of the engineers to whom this work was entrusted.

Result of the Gordon Bennett Balloon Race

As we go to press nineteen out of the twenty balloons which left Stuttgart on the 27th ultimo, in the Gordon Bennett race have been reported. The race appears to have been won by the French balloon "Picardie," piloted by M. Maurice Bienaimé, with M. Rumpelmayer as aide. This aerostat covered a distance of 2,000 kilometers (1,367 miles) in 46 hours, thus breaking the world's record of 1,211 miles, held by M. Emil Dubonnet, as well as the record of 1,172 miles made last year in this race by Alan R. Hawley, when he traveled from St. Louis to the wilds of Canada. M. Bienaimé landed at Riazan, near Moscow. The French "Ile de France," piloted by Alfred Lablanc, also landed in Russia, about 125 miles short of the distance covered by the "Picardie." The third French balloon, the "Bearn," and the English "Honeymoon" appear to have tied for third place with 1,800 kilometers (1,118½ miles) to their credit, the "Uncle Sam" being next with 1,056 miles.

The third American balloon, "Düsseldorf II.," piloted by Mr. John Watts, who had Mr. Arthur T. Atherholt as aide, had not been heard from up to November 1st, and it was feared this German aerostat, which was loaned the Americans at the last moment owing to a defect developing in their own, had been lost at sea.

This is the first time France has won the international balloon race, and no doubt her aeronauts will make every effort to keep both the balloon and aeroplane trophies at home in the future. No less than nine countries competed this year.

RICE'S MILL WHITE

"The Paint that Brims Over With Sunlight"

Not a Cold-water Paint

White, glossy, light-reflecting ceilings and walls are an actual asset to a mill owner. They mean a healthful and *helpful* environment for operatives. They mean increased output because of improved working conditions. They mean economy in the care and upkeep of a mill property.

These conditions are best attained by using Rice's Mill White. This is a remarkable paint. It possesses an elastic quality which makes flaking and scaling an impossibility. It stays white longer than any other gloss white, ordinary conditions having no yellowing effect upon it. It spreads easily without dragging and gives a firm yet elastic surface impervious to dust and germs.

Hosiery Mill Before Using

If you have 20,000 or more square feet of ceiling and wall space to cover, write us on your letter head for a free sample board, showing its fine surface and high reflective power, and our booklet, "Make the Most of Daylight in Your Plant." Address

Hosiery Mill After Using

U. S. Gutta Percha Paint Co.
23 Dudley St.
Providence, R. I.

Originators of the Mill White Idea

TEXTILE WORLD RECORD

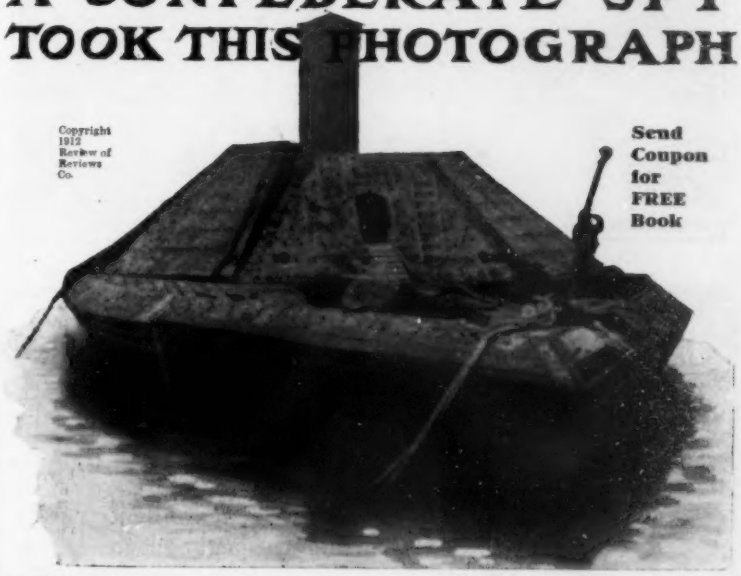
The Magazine for the Mill Trade

It is the oldest and most widely quoted textile periodical. It covers the manufacturing end of the textile industry, which is the greatest single group of manufacturing industries, the largest user of motive power, and the biggest employer of labor.

It is a mill paper devoted to the machinery and processes of making yarn, cloth, fabrics, knit goods, etc., as distinguished from the selling and distributing branch of the business. If interested in the textile industry you should *read* the TEXTILE WORLD RECORD. If you sell to textile mills you should *advertise* in it. Sample copies, subscription and advertising rates, etc. free to those mentioning *Scientific American.*

LORD & NAGLE COMPANY, 144 Congress St., Boston, Mass.

A CONFEDERATE SPY TOOK THIS PHOTOGRAPH



Copyright 1912 Review of Reviews Co.

Send Coupon for FREE Book

STARTLING reminder of the adventure—the daring, the reckless courage of those hot days fifty years ago is this photograph taken by Lytle of the Confederate Secret Service along the Mississippi. He slipped through the Union lines and photographed the cavalry in formation, the men in camp, regiments ready for battle—all as information for the Confederate Generals. And now you can own these strange photographs, telling the very secret heart of history—in your set of the

Photographic History of the Civil War

3800 Photographs Ten Magnificent Volumes, Beautifully Bound A Million Words

Like the American public, the Review of Reviews was delighted and amazed by the discovery of the famous Brady lost Civil War photographs after their 50 years burial. But they felt sure that there must have been other camera men as daring—who followed Brady into the field of battle. So searchers were sent to all parts of the country. The result was startling.

Some photographs found were taken by Gardner, Brady's Scotch assistant; some by photographers officially attached to one section or the other of the Union Army. Some were taken by Confederates—Cook who had his headquarters in Charleston, by Edwards of New Orleans, by Davies of Richmond. Their work had gone to precious private collections, to old people who treasured a single photograph—to forgotten albums. All these—by an enterprise as romantic as the pictures themselves—have been recovered—and now you can own them together with the million word history written by 50 famous men of the North and South.

A $15.00 Saving

Send for Book of SAMPLE PAGES FREE

Knowing that—owing to the beginning of royalty payments on thousands of the rare photographs—the Review of Reviews had to advance the price of the **Photographic History $15, John Wanamaker arranged** quickly for one special edition at the present price.

A number of the famous photographs in sample pages of this monumental work, will come to any adult **FREE** on receipt of the coupon. At the same time you will learn how you can save money on your set and pay for it in little monthly payments. **Be prompt and save $15.**

John Wanamaker, New York

CUT OFF AND MAIL TODAY

Sci. Am. 11-9-12

JOHN WANAMAKER, New York City:

Send me 12 rare and interesting war-time photographs, shown in 16 sample pages of the **Photographic History of the Civil War.** I am interested in your offer to save me $15.00, but am to be under no obligation.

You are to send the sample pages containing the photographs absolutely free and charges paid.

Name .....

Address .....

Occupation .....

When you realize what a large percentage of your yearly tire expense is due directly to *"oil disease"* you'll lose no time in ordering a set of

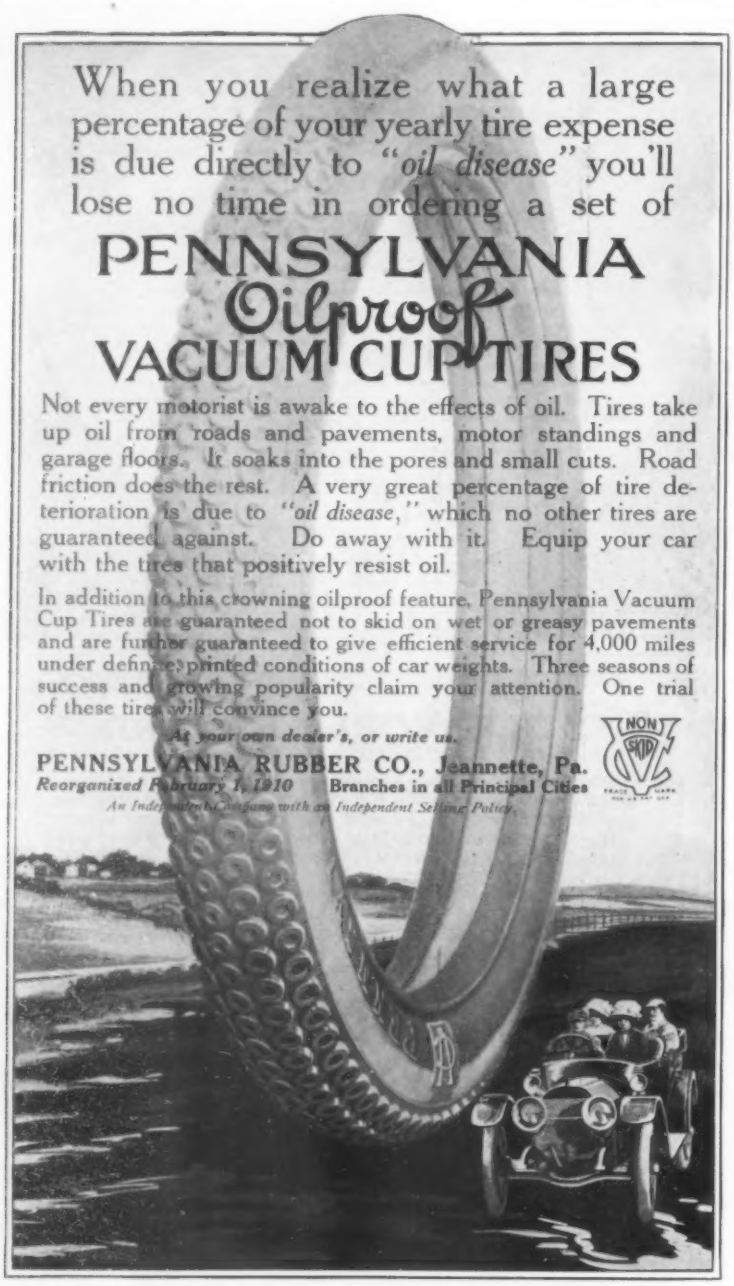
PENNSYLVANIA
Oilproof
VACUUM CUP TIRES

Not every motorist is awake to the effects of oil. Tires take up oil from roads and pavements, motor standings and garage floors. It soaks into the pores and small cuts. Road friction does the rest. A very great percentage of tire deterioration is due to *"oil disease,"* which no other tires are guaranteed against. Do away with it. Equip your car with the tires that positively resist oil.

In addition to this crowning oilproof feature, Pennsylvania Vacuum Cup Tires are guaranteed not to skid on wet or greasy pavements and are further guaranteed to give efficient service for 4,000 miles under definite printed conditions of car weights. Three seasons of success and growing popularity claim your attention. One trial of these tires will convince you.

At your own dealer's, or write us.

PENNSYLVANIA RUBBER CO., Jeannette, Pa.
Reorganized February 1, 1910 Branches in all Principal Cities
An Independent Company with an Independent Selling Policy



Cheap Reliable

POWER

We have an engine built for service—built exceptionally well and simply—and built to operate cheaply.

THE ADAMS KEROSENE
GAS ENGINE

This engine burns kerosene, which means low cost of operation. It has the Secor-Higgins system of carburetion—the only successful system of burning cold kerosene.

The quantity of gas and air is automatically controlled by the governor in exact proportion to the speed and load—assuring complete combustion and smokeless exhaust.

This is the right engine for irrigation farmers, small millers and manufacturers, cotton gin operators and small town light and pumping stations.

It is built in sizes from 50 to 170 h. p.—suitable for all belt driving or direct connection to an electric generator.

Write for details of this engine.

RUMELY PRODUCTS CO., Inc.
La Porte, Ind.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12693) H. N. M. writes: In expounding the phenomena of thunder some time ago, I gave the following theory, which I now find to be entirely different from the accepted theories: When electricity passes through water, it decomposes it, producing hydrogen and oxygen, the amount of gas produced varying with the strength or volume of electric current. The heat that decomposes the water, in the case of lightning, ignites the gas, which is reconverted back to water with a terrific explosion, which in a thunder storm is called thunder. When a flash of lightning passes along a cloud horizontally, sometimes in the moisture and sometimes out, it decomposes the water and ignites the detonating gas in its train, and an extended, intermittent, rolling peal of thunder is heard. If it passes through the cloud toward the earth, a short report is the result. Now lightning passing through the air from a cloud to the earth produces no thunder. I have heard it strike a tree close by with a short splitting sound, but the thunder is not heard until after a sufficient lapse of time for the sound to travel from the cloud to the earth. This proves to my mind that water must be present and detonating gas produced, or there can be no thunder. In passing an electric current through water and producing a bubble of detonating gas, the size of a pea, on ignition a report is heard like that of a pistol; so one can readily conceive what terrific reports would accompany the passage of the tremendous amounts of electricity or lightning through a cloud. A. It may be that some small quantity of water is separated into its oxygen and hydrogen when a flash of lightning passes through the moist air of a shower. But the quantity cannot be large in the short interval of time while the flash passes. It is possible also that a part of the heating effect of lightning may be due to the burning of this decomposed water. We doubt whether the burning of the oxygen and hydrogen contributes very greatly to the detonation of the thunder. The usual explanation that the sound of the thunder is caused by the rupture and heating of the air, thus expanding it violently, with its immediate recoil and closing in upon the tube through which the electricity has just passed, seems to us to be quite sufficient. The air claps its hands, as it were, after the lightning forces them apart. The rum'bling of the thunder, the prolongation of the soun'l, is believed to be due to reflections from the uneven surface of the earth and the clouds. There is less rumbling of the thunder at sea, where the earth's surface is smoother. There is most in the mountains. We should accept the statement of the International Encyclopedia of 1903 as representing the usual view of scientific men. We would add that the familiar snap of the spark from an electric machine is only a tiny thunder clap, which is produced equally as loud and strong in air artificially dried, so that no decomposition of water is possible. As you have observed, there is no prolongation of the thunder when the flash occurs very near, since all parts of its path are at about the same distance from one's ear. The short snap is as really thunder as the prolonged rumbling sound.

(12694) P. N. J. asks for formulas for flashlight powders. A. 1. Magnesium powder, 6 ounces; potassium chlorate, 12 ounces; antimony sulphide, 2 ounces; 75 to 150 grains of the powder should be used. 2. Guncotton, 15 grains, and magnesium powder, 30 grains, are used. 3. Magnesium, 40 per cent; permanganate of potassium, 40 per cent; peroxide of barium, 20 per cent. 4. Purchase 1 ounce of magnesium powder and 1 ounce of negative guncotton from dealers in photographic materials. Place on a dustpan enough cotton, when pulled out, to measure about 3½ inches in diameter. Sprinkle it over with 20 grains of magnesium powder to form a thin, even film. Lay over the magnesium, thus arranged, a very thin layer of guncotton. Connect to the bunch of cotton a small fuse of twisted cotton about 6 inches long, so that it will extend to the side of the dustpan. Then set the pan on a step ladder near the object, and, when ready, light the guncotton fuse with a match, when instantly a brilliant flash will ensue. There are several ready prepared magnesium compounds now sold, with special devices and lamps to fire them. 5. For photographing the interior of very large caves in such a manner as to bring out every possible detail, the following is recommended: Magnesium, in powder, 20 parts; barium nitrate, 30 parts; flower of sulphur, 4 parts; beef suet, 7 parts. Melt the suet, and add the other ingredients after having first mixed them by passing through a fine sieve. When thoroughly stirred in, pour the mass into zinc boxes of a suitable size. A box 3 inches in diameter and 4 inches deep will hold about 1 pound, and will give a flash of 20,000 candlepower. Such a flash, used in signaling in France, has been seen at a distance of 100 kilometers, or about 62 miles. 6. German patents have been granted on a series of slow combustion flashlight powders of the following composition: (*a*) Potassium permanganate, 30 parts; zinc filings, 10 parts; magnesium powder, 10 parts; iron, fine filings, to 100 parts. (*b*) Potassium nitrate, 30 parts; iron, fine filings, 30 parts; magnesium powder, 20

Why Pay Garage Bills?

Put an end to garage and storage bills—have your car always handy, day or night, in a Pruden System

Portable Fireproof Garage

—Can be erected, if desired, on rented property. Appears to advantage in the most high class surroundings. *Solves the problem of low cost fireproof construction.* With the

Pruden System
of Interlocking Self-Structuring Metal Units

no frame-work is needed. No wood used. We ship complete buildings in beautifully embossed designs. Strong, durable and handsome as masonry.

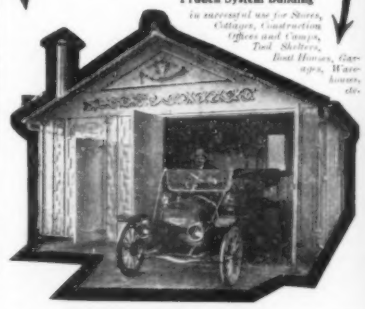
A demonstrated success for three years. Not crude or experimental, and nothing else like it. We own the patents and are sole manufacturers.

You and one helper can easily erect. Will last life time without repair expense.

Write today for catalog mentioning name and model number of your car so that we may advise as to what you need. Freight prepaid east of Rocky's. All orders immediately shipped from stock.

METAL SHELTER CO.
5-52 W. Water St. St. Paul, Minn.

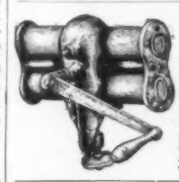
Pruden System Building
in successful use for Stores, Cottages, Construction Offices and Camps, Tool Shelters, Boat Houses, Garages, Warehouses, etc.



CRUDE ASBESTOS
DIRECT FROM MINES

PREPARED Asbestos Fibre for Manufacturers use

R. H. MARTIN
OFFICE, ST. PAUL BUILDING
220 Broadway, New York

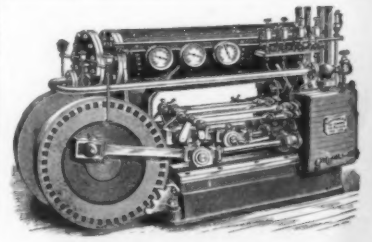


AGENTS

Send for our proposition on the Hawthorne Four Cylinder Automobile Hand Air Pump.

HAWTHORNE MFG. CO., Inc.
38 Spruce Street, Bridgeport, Conn

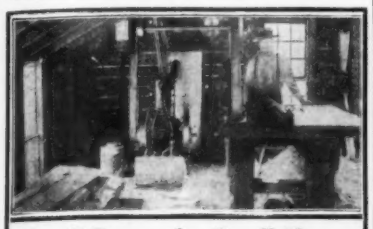
A LIBRARY OF PHOTOGRAPHIC INFORMATION
THE 'WELLCOME' PHOTO EXPOSURE RECORD AND DIARY
With reliable Exposure Calculator.
50 cents. All Dealers or direct.
BURROUGHS WELLCOME & Co.
35, West 33rd St., N.Y.
or 101, Coristine Bldg., MONTREAL



The Allen
Dense-Air Ice Machine

contains only air—no chemicals. Nearly 300 are in daily use in the tropics on men-of-war, merchant steamers, and steam yachts—a number of them running over twenty years.

H. B. ROELKER
41 Maiden Lane New York City



Small Power for Small Shops

Every owner of a home work shop, wood shop, machine shop, blacksmith shop, tin shop, candy shop, print shop or, in fact, any kind of shop, should investigate

I H C Small Gasoline Engines

They give reliable power at a surprisingly small cost. Simple, easy to start, and will last as long as the machines they operate. I H C engines require no attention while running except a little lubricating oil every hour or two. Built in sizes and styles for every shop, 1, 2, 2½, 3, 4, 6, and up to 50-horse power—air cooled, tank cooled or hopper cooled, either horizontal or vertical. Write for catalogue.

International Harvester Company of America
(Incorporated)
15 Harvester Building Chicago, U S A

Use KEROSENE Engine Free!

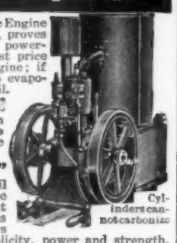
Amazing "DETROIT" Kerosene Engine shipped on 15 days' FREE Trial, proves kerosene cheapest, safest, most powerful fuel. If satisfied, pay lowest price ever given on reliable farm engine; if not, pay nothing. No waste, no evaporation, no explosion from coal oil.

Gasoline Going Up!

Gasoline is 9c to 15c higher than coal oil. Still going up. Two pints of coal oil do work of three pints gasoline.

Amazing "DETROIT"

—only engine running on coal oil successfully, uses alcohol, gasoline and benzine, too. Starts without cranking. Only three moving parts—no cams—no sprockets—no gears—no valves—the utmost in simplicity, power and strength. Mounted on skids, all sizes, 2 to 20 h. p., in stock, ready to ship. Engine tested before crating. Comes all ready to run. Pumps, saws, threshes, churns, separates milk, grinds feed, shells corn, runs home electric lighting plant. **Prices** (stripped), **$29.50 up.** Sent any place on 15 days' Free Trial. Don't buy an engine till you investigate money-saving, power-saving "**Detroit.**" Thousands in use. Costs only postal to find out. If you are first in your neighborhood to write, you get **Special Extra-Low Introductory** price. Write 138
DETROIT ENGINE WORKS, 127 Bellevue Ave., Detroit, Mich.


Cylinder can be carbonized

Learn Watchmaking

We teach it thoroughly in as many months as it formerly took years. Does away with tedious apprenticeship. Money earned while studying. Positions secured. Easy terms. Send for catalog.

ST. LOUIS WATCHMAKING SCHOOL, St. Louis, Missouri

LEARN AERONAUTICS

by Building and Flying "Ideal" Model Aeroplanes

The easiest way to **learn** the **principles** of the wonderful **science of Aeronautics** is to build and fly Model aeroplanes. **We guarantee** Models built from **"Ideal" plans** and with **"Ideal" materials to fly.** **"Ideal" Bleriot Monoplane,** complete parts, plan and instructions $4 prepaid. Plan only, 15 cents. **"Ideal"** three foot **Racer** can be built in **one hour** and flown **1000 feet.** Complete parts $2, prepaid, (with patent friction winder, $2.50). Send stamp for **price list** of other **successful flyers.** 40 pp. Model Aeroplane Supply Catalog **5c.**
Ideal Aeroplane & Supply Co., 83-84 West Broadway, New York

TELESCOPES

CATALOGUE FREE
W. & D. MOGEY
PLAINFIELD, N. J.

PALMER MOTORS AND LAUNCHES

2 AND 4 CYCLE

Catalogue M Free of Motors.
Catalogue B Free of Boats.

ENGINES FROM 2 TO 40 H.P. IN STOCK
PALMER BROS., Cos Cob, Conn.

MASON'S NEW PAT. WHIP HOISTS

save expense and liability incident to elevators. Adopted by principal storehouses in New York and Boston
Manufactured by VOLNEY W. MASON & CO., Inc.
Providence, R. I., U. S. A.

OILDAG

Reg. U. S. Pat. Off.

Is the only oil lubricant that contains graphite in colloidal form. It is an ideal lubricant for Steam Cylinders, Gas Engines, Bearings and for general use, and is sold in concentrated form to be mixed with oil. No Automobile, Motor Boat or Motorcycle is run at highest efficiency without it.

Write for Booklet L-458.

International Acheson Graphite Co.
Niagara Falls, N. Y.
General Agents for Oildag, made by Acheson Oildag Company

GET THIS-NOW

Write at once for *free* sample bottle of this wonderful household necessity.

"3 in One" is the best and only oil on earth for oiling everything properly. Cleans and polishes and positively prevents rust. No housewife should try to get along without it.

If you have never used "3 in One" on sewing machines, piano cases, fine furniture, bathroom fixtures, brass railings, doorplates, hinges, cutlery, etc., try it—*now*—at our expense. When you write for sample send name of your dealer.

"3 IN ONE" OIL CO.
42 AZH Broadway, New York City

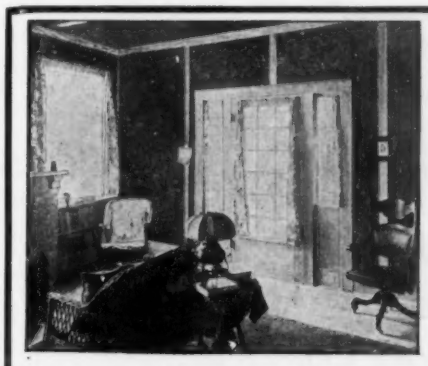
parts; aluminium powder, to 100 parts. (c) Barium peroxide, 33.3 parts; magnesium powder, 33.3 parts; aluminium powder, 33.3 parts. When any of these powders is ignited it gives, at first, a reddish light, of low actinic value; the light gradually becomes more and more intense, until a maximum of actinic effect is reached. This slow combustion offers an advantage over the old rapidly acting flashlight powders, in that the eyes of sitters become gradually accustomed to the flash; hence the pictures do not present the staring eyes that are so offensive in the majority of flashlight photographs.

(12695) F. R. M. asks: I have heard many times that if a hot-water pipe and a cold-water pipe are equally exposed to freezing temperature, the hot-water pipe will freeze first. If this is so, what is the explanation? A. It is believed that the fact that the air has been separated from the water in the hot-water pipes causes these pipes to freeze sooner than the cold-water pipes.

(12696) B. N. K. asks how to make sheet wax. A. 1. Take of pure, clean wax, anywhere from 1 to 5 pounds, put in a tin bucket or any deep vessel, with clear water sufficient to fill it within 2½ inches of the top. Set on the stove till thoroughly melted, then set aside until partially cooled; skim all the air bubbles off. Then fill a smooth, straight bottle with ice water, a bucket of which you should have by you. Soap the bottle, and dip it deliberately in the solution two or three times, according to the thickness you desire your wax. After the last dip, as soon as the wax hardens to whiteness, cut a line through it and remove it from the bottle as quickly as possible. Spread to cool, and straighten out smooth while warm. Continue this process until all the wax is made into sheets. 2. Melt scrap wax in hot water, and add sulphuric acid, 30 minims to each pound of wax. Boil for 2 or 3 minutes. Cool, and remove impurities from base of cake; boil again, and add a few drops of turpentine. When the liquid ceases to foam the wax is ready for rolling into sheets. Stretch wires of suitable thickness across a glass plate to form molds of desired size. Wet a glass rolling pin, and coat with soapstone. Pour the melted wax into the molds and pass the roller firmly over the wires.

(12697) J. M. R. asks: Recently I heard the assertion made that it was a fact that people on one of the other planets had been seen by people on the earth and an attempt had been made to send a message to them, and that the best that could be told, that an attempt had been made by them to answer the message. I have never seen any account of this, and do not believe it to be true, but am writing to you to know the facts in the case. A. The only planet about which any suggestion has been made that we might signal to the inhabitants is the planet Mars. When this ruddy heavenly body is in its most favorable position, a space something less than 30 miles square could be seen with a telescope. A few years ago an astronomer said that he saw tiny points on Mars brighter than the body of the planet. The suggestion was immediately made in the newspapers that these were fires made by the Martians to attract our attention, and that we ought to answer them. Nothing has been done in that direction. Sir Robert Ball pointed out that "a flag to be used as a wigwag would need to be 300 miles long and 200 miles wide with a staff 500 miles long. If we would signal by a fire, and Lake Superior were filled with kerosene and set on fire, the resulting blaze might be discerned as a speck of light, but not sufficiently prominent to suggest that anything unusual was in progress. Such illustrative comparisons are not encouraging to those who would undertake to signal to the inhabitants of other worlds.

(12698) B. J. C. asks how to soften horn. A. The bony core of the horn is first removed; the next process is to cut off with a saw the tip of the horn; that is, the whole of its solid part, which is used by cutlers for knife handles and sundry other purposes. The remainder of the horn is left entire, or is sawn across into lengths, according to the use to which it is destined. Next, it is immersed in boiling water for half an hour, by which it is softened, and while still hot is held in the flame of a coal or wood fire, taking care to bring the inside as well as the outside of the horn, if from an old animal, in contact with the blaze. It is kept there till it acquires the temperature of molten lead, or thereabout, and in consequence becomes very soft. In this state it is slit lengthwise by a strong pointed knife, like a pruning knife, and by means of two pairs of pincers, applied one to each edge of the slit, the cylinder is opened nearly flat. The degree of compression is regulated by the use to which the horn is afterward to be put. When it is intended for leaves of lanterns, the pressure is to be sufficiently strong (in the language of the workmen) to break the grain, by which is meant separating in a slight degree the laminæ of which it is composed, so as to allow the round-pointed knife to be introduced between them, in order to effect a complete separation. For combs, the plates of horn should be pressed as little as possible, so that the teeth may not split at the points. They are shaped chiefly by means of rasps and scrapers of various forms, after having been roughed out by a hatchet or saw; the teeth are cut by a double saw fixed in a back, the two plates being set to different depths, so that the first cuts the teeth only half way down, and is followed by the other, which cuts the whole length; the teeth are then finished and pointed by triangular rasps. Horn for knife handles is sawn into blanks, slit, pared and partially shaped, then heated in water and pressed between dies. It is afterward scraped, buffed and polished.



No muss,
no bother,
no tedious waiting for the plaster to dry, and no cracked walls afterward.

Utility Wall Board

takes the place of both lath and plaster. It is nailed to the studding and is easily and quickly put on. It will not shrink, or warp, or crack, and it will last as long as the house stands.
Makes beautiful walls and ceilings. May be decorated in any way desired. In repair work may be put on over old plaster if desired. It is not expensive. *Send for Free Sample and Illus. Book.*

THE HEPPES COMPANY, 4518 Fillmore St., Chicago, Ill.

$13,400.31 on the Side

Mr. F. H. Dunlap of West Salisbury, N. H., in the past twenty-five years has cleared $13,400.31 from hens. This is a remarkable record, when it is known that Mr. Dunlap is employed ten hours a day in a store and all the time he has to put in with his hens is what he can get morning, noon and night. This $13,400.31 was all made on the side. Nor does Mr. Dunlap get fancy prices for what he has to sell. He ships to Boston, and takes current quotations from the commission men there. Mr. Dunlap began in 1887 with twenty hens. In 1910 his poultry profits figured out $1,188.05—and this is all on the side. Mr. Dunlap's hens have bought him a beautiful home, purchased a horse and carriage, sent three boys to school and college, besides saving something for a rainy day. Can others do equally well? "Sure thing," says Mr. Dunlap, "if they will wear out the soles of their shoes, faster than they do the seat of of their chair." The story of Mr. Dunlap's success and his methods is told in the book, "Side-Line Poultry Keeping," and it is only one out of a score of things to set the blood tingling and make one resolve to get next to the $600,000,000 spent in the United States each year for poultry and eggs.

$1,009.31 R. A. Richardson of Haverhill, Mass., a shoe cutter, made his hens pay him $1,009.31 in 1910, and kept working at the bench at the same time. How he did it is told in "Side-Line Poultry Keeping."

"SIDE-LINE POULTRY KEEPING"

is the name of a new book by the author of "200 Eggs a Year Per Hen," the most popular poultry book ever printed. "Side-Line Poultry Keeping" deals with the business side of poultry keeping as the other dealt with egg production. It tells how to make poultry keeping pay. It describes the methods by which F. H. Dunlap of West Salisbury, N. H., makes over $1000 a year from eggs, devoting not over two hours a day to his hens. Not a detail left out. The book tells how to make a start, what breeds pay, how, when and where to buy a farm, how to make a living from the first, describes the most wonderful brooding system in the world, tells how to build the most economical poultry houses and trap nests, how to feed for best results, describes a feed that can be made for 15 cents a bushel and is without a peer for producing eggs, how to make money with pigeons, ducks and market gardening, how to buy and sell to advantage, how to pick out the laying hens, how to put down eggs so that they will keep a year, etc.

Invaluable to every man who wishes to make money on the side, and indispensable to the man who is looking forward to the free, independent, healthful life of the poultry farm. Ninety-six pages; illustrated. **Price 50 Cents,** or with the American Poultry Advocate one year 75 cents, two years' subscription and book for $1.00, or given as a premium for two yearly subscriptions at 50 cents each. Our paper is handsomely illustrated, 44 to 124 pages, 50 cents per year. 3 months' trial, 10 cents. **Sample free.** Catalogue of poultry books free.

American Poultry Advocate, 226 Hodgkins Block, Syracuse, N. Y.

Their past goodness is history — their future goodness is assured by the Liggett & Myers signature.

Richmond Straight Cut

Cigarettes Cork Tip or Plain

Favorites for over thirty years

The last census shows that our population has increased from 50 millions to 100 millions since Richmond Straight Cuts first made their appearance.

As our country grows, so has grown the popularity of this best of all Virginia Cigarettes.

20 for 15c

Liggett & Myers Tobacco Co.

1900

Over 3000 "RED DEVIL" Tools are made for mechanics, and each tool is the most perfect tool made in it's particular class.

No. 1900 "RED DEVIL" Staple Puller. 11 inch Drop Forged Tool Steel. A tool that anyone will admit is absolutely perfect, and the only staple puller made that does everything the fence builder requires. We guarantee this "Red Devil" tool absolutely. We know you will appreciate this dependable tool. If you want one sample send us **$1.25** and it will go prepaid. But one only at this price. We are **not** retailers.

GENUINE "RED DEVIL" TOOLS

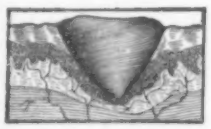
are sold by leading retailers in all parts of the world. Just ask for them. Insist on **"RED DEVIL"**; accept no substitute. But if you cannot obtain them from your local dealer, write us giving your dealer's name.

542

Here's that famous "RED DEVIL" No. 542—a 6½ inch drop forged steel diagonal side cutter. It's the most powerful and popular plier of its kind we make. It's guaranteed absolutely. It will cut anything in the wire line. It's a cutting plier any mechanic will recommend. A sample pair will be sent post paid for **75 cents.**

SMITH & HEMENWAY CO. **150-152 Chambers St., New York, U. S. A.**
SMITH HARDWARE CO., Ltd., Montreal, Canada

Here's a "7 Wheel RED DEVIL" Glass Cutter. It's one of the 40 styles we make. If you cut glass use "RED DEVIL" Glass Cutters. On receipt of **ten two-cent stamps** ONE ONLY No. 5 "RED DEVIL" will be sent you as a sample prepaid.



Here's a Corn

And Here's the Way to End It

To pare that corn means to cut off the top of it. The rest is left to grow. Then you pare it again, and so on forever. If you let the blade slip it may cause infection.

Every old-fashioned treatment is equally useless. The only way to end the corn is to remove it.

There is now a wax which does this—the B & B wax. It is used in the Blue-jay plaster.

This little plaster is applied in a jiffy, and the pain stops instantly. Then the wax very gently undermines the corn. In 48 hours you can lift the corn out, without any pain or soreness.

Don't doubt this, for sixty million corns have been removed in just this simple way. End yours in that way *now*.

A in the picture is the soft B & B wax. It loosens the corn.
B protects the corn, stopping the pain at once.
C wraps around the toe. It is narrowed to be comfortable.
D is rubber adhesive to fasten the plaster on.

Blue-jay Corn Plasters

Sold by Druggists—15c and 25c per package

Sample Mailed Free. Also Blue-jay Bunion Plasters.

Bauer & Black, Chicago and New York, Makers of Surgical Dressings, etc. (256)

The Inimitable Spoon Feed IN Waterman's Ideal Fountain Pen

The hair-spring in a watch is no more carefully made and adjusted than is this famous Spoon Feed. It is *now* regulating the ink flow in over 25 million Waterman's Ideals.

The success of the spoon feed developed the Fountain Pen industry. It made possible the carrying of ink in your pocket, to be used instantly for writing, without soiling your clothes or fingers. It prevents the proverbial shake, for starting the ink to flow. When the pen point of a Waterman's Ideal touches paper it starts to mark, it continues without blot, scratch or skip as long as your hand guides it. There are other flat feeds but not Spoon Feeds. The Spoon Feed is used exclusively in the three successful types of Waterman's Ideals,—

REGULAR—SAFETY and SELF-FILLING

From the best stores in all localities

L. E. Waterman Company, 173 Broadway, N. Y.

NEW BOOKS, ETC.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. New York, 1912. 4to.; 1575 pp.; Price, $10.

The twenty-first annual edition of "Hendricks' Register," as it is apt to be called for short, is larger and better than ever. The new plan, which was adopted last year, of giving each subject a number has been retained, making reference to the subjects from the index extremely easy. It would be hard to get along without this useful book, five copies of which are in constant use in our office. This book furnishes complete classified lists of manufacturers, for the benefit of those who want to buy, as well as for those who have something to sell. It covers very completely the architectural, engineering, electrical, mechanical, railroad, mining, manufacturing, and kindred trades and professions. The index alone covers 122 pages, which will give the reader some idea of the comprehensiveness of the book. The total number of classifications in the Register is over 50,000, each representing the manufacturer or dealer in some machine, tool, specialty, or material required in the architectural, engineering, mechanical, electrical, railroad, mine, and kindred industries. There are 385 pages of new matter, and the whole represents upward of 385,000 names and addresses. The trade names of all articles classified in the Register are included, as far as they can be secured, thus adding greatly to the value of the book. No business office is complete without this volume, which is as necessary as the telephone.

THE PRINTING ART. Vols. XVII, XVIII, XIX. Cambridge, Mass.: The University Press. 4 to 527 pp. average.

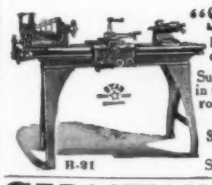
A few years ago a "printer" was about in the same category as a plumber or other master of a hand-trade. Now, however, a modern printer is regarded more as a professional man—a designer and clothier of business and other literature. The reasons for this renaissance are numerous. The ancient "rule-twisters" that made a billhead look like a typographical St. Bartholomew are no more, their lack of art died with them. The type foundries learned that the cost of lead and antimony was the same when cast in "Cheltenham" or "Caslon" or "Scotch" as when cast in some of the mid-Victorian typographical horrors. Lastly, but not least, a quiet force entered the field, and by means of the press itself sought to uplift this important field of endeavor and succeeded. We refer to *The Printing Art*. This charming periodical is an illustrated monthly magazine devoted to the graphic arts. The job is admirably done, and done with exquisite taste. It is indeed a clearing house of typographical excellence. No product of the "art preservative" is too humble to be considered. The business card, the menu, the catalogue, the fashion plate, the magazine, the exquisite privately printed book. Everything in design; paper and print is germane to the scope of this periodical, which occupies its niche so well. The bound volumes before us are a wonderland of beauty, with most illuminating text. The advertisements and covers are all bound in, as they should be. This monthly is found on the desks of many buyers of printed matter, and the shrewd business man when he selects a new printer is apt to look around the exhibition room—furtively perhaps—to see if the row of familiar green-backed volumes are there, or at least a pile of unbound copies. *The Printing Art* has been an immense power for good.

WHERE TO LIVE ROUND LONDON: SOUTHERN SIDE. By W. H. Shrubsole, F.G.S. Edited by Prescott Row and Arthur Henry Anderson. London: The Homeland Association, Ltd. New York: F. Warne & Co. 16mo., 228 pp. Price, 40 cents.

The Homeland Association takes up interesting places in England, and publishes complete monographs on them and does them well. No phase of the subject is omitted. The geological formation, water, climate, ways of communication, rents, hotels, schools, places of worship, recreation, etc., are all treated. London itself does not offer many charms to the permanent resident except possibly those of the Park Lane class, but the beautiful suburbs, particularly to the south of London, and places farther afield offer ideal homes, and this book describes them. The many lovers of England (and the United States is filled with them) should welcome with enthusiasm this and every other volume issued by the Homeland Association. The book is well illustrated with engravings, which makes one homesick for the motherland, which can only be visited at long intervals and with the expenditure of much hard-earned time and money.

SOUTHERN ENGLAND, COAST AND COUNTRYSIDE. Kent, Sussex, Hants, Isle of Wight. London: The Homeland Association. New York: F. Warne & Co. 16mo.; 218 pp. Price, 40 cents net.

This book tells where to stay, what to see, where to live, what to do, where to educate children, where to play golf, and all the countless things which one wants to know when the doctor intimates that possibly a summer spent in southern England would give surcease from the boiler-shop activity of our American existence. It is a most fascinating little book, which should be prized by all who love their England. It belongs to a series of books which shows that it is not


B-91

"STAR" Large Line of Attachments
For Foot or Power **LATHES**
Suitable for fine accurate work in the repair shop, garage, tool room and machine shop.
Send for Catalogue B
SENECA FALLS MFG. CO.
695 Water Street
Seneca Falls, N. Y., U.S.A.

SEBASTIAN LATHES
9 to 15 Inch Swing
High Quality *Low Prices* *Catalog Free*
THE SEBASTIAN LATHE CO., 120 Culvert St., Cincinnati, O.

This GRINDER

Has no pumps, no valves. No piping required to supply it with water. Always ready for use. Simplest in construction, most efficient in operation. *Price will interest you.*

W. F. & Jno. Barnes Co.
Established 1872.
1999 Ruby St. Rockford, Ill.

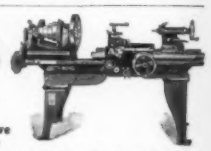
"Responding to the Call"

from the practical mechanic for a Breast Drill that shall eclipse all existing Tools of the kind, we are pleased to introduce the "A. J. W. & CO." BREAST DRILL with Gear Locking Device.

It has all the strong, useful and practical points of existing Drills, and REAL improvements added that are peculiar to itself. PRICE, $5.50

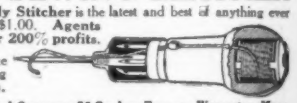
A. J. WILKINSON & CO., *Machinery*
184-188 Washington Street Boston, Massachusetts

SOUTH BEND LATHES
Screw Cutting
9 to 18-inch Swing
Straight or Gap Bed
Power, Foot & Electric Drive
Interesting Catalog Free



South Bend Machine Tool Co., 421 Madison St., South Bend, Ind.

FOR SEWING LEATHER
The **Speedy Stitcher** is the latest and best of anything ever offered for $1.00. **Agents make over 200% profits.**
Send at once for catalog and terms.



Automatic Awl Company, 56 Gardner Terrace, Worcester, Mass.

WANTED—SALESMEN AND SALESWOMEN
Hundreds of good positions now open paying from $1,000.00 to $5,000.00 a year. No former experience required to get one of them. We will teach you to be a high grade Traveling Salesman or Saleswoman by mail in eight weeks and assist you to secure a good position where you can earn good wages while you are learning Practical Salesmanship. Write today for full particulars, and testimonials from hundreds of men and women we have recently placed in good positions; also list of good positions open. Address nearest office: Dept. 122
National Salesmen's Training Association
Chicago New York Kansas City Seattle New Orleans Toronto

THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES.
BRIDGEPORT CONN.

Experimental & Model Work
Circular and Advice Free
Wm. Gardam & Son, 82-86 Park Place, N. Y.

MODELS CHICAGO MODEL WORKS
ESTABLISHED 1867 156 W. MADISON ST. CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES

RUBBER Expert Manufacturers Fine Jobbing Work
PARKER, STEARNS & CO.,
288-290 Sheffield Ave., Brooklyn, N. Y.

ICE MACHINES Corliss Engines, Brewers and Bottlers' Machinery
***The* VILTER MFG. CO.**
899 Clinton Street, Milwaukee, Wis.

WE MANUFACTURE FOR YOU
Novelties and **Specialties** of all kinds by contract. Expert workmen; exceptional factory facilities. Prices reasonable. Write for estimate on your work.
AJAX HARDWARE MFG. CO., 1191 MILITARY ROAD, BUFFALO, N. Y.

INVENTORS We manufacture METAL SPECIALTIES of all kinds, to order; largest equipment; lowest prices. Send perfect sample for low estimate and best expert advice **FREE**
THE EAGLE MFG. CO., Dept. A, Cincinnati, O.

Money in This Print your own cards, circulars, book, newspaper. PRESS $5, larger $18. Rotary $60. All easy, rules sent. Print for others—big profit. Write factory for press catalog, TYPE, cards, paper, etc.
THE PRESS CO., Meriden, Conn.

Magical Apparatus
Grand Book Catalog. Over 700 engravings 25c. Parlor Tricks Catalog Free.
MARTINKA & CO., Manufacturers, 493 Sixth Avenue, New York

WANTED To manufacture METAL SPECIALTIES, 20 years experience in making Dies, Tools and Special Machinery. Expert work. Complete equipment.
NATIONAL STAMPING & ELECTRIC WORKS
Dept. 2, 412 So. Clinton Street, - Chicago, Ill.

MODELS and experimental work on clocks, meters, novelties, etc. Special machinery. Small wheel and pinion cutting to order. Manufacturing.
LUX MODEL WORKS Waterbury, Connecticut

VEEDER Counters

to register reciprocating movements or revolutions. Cut full size. Booklet free.

VEEDER MFG. CO.
18 Sargeant St. Hartford, Conn.

Cyclometers, Odometers, Tachometers, Counters and Fine Castings.

Price $1.00

Represented in Great Britain by Markt & Co. Ltd., 6 City Road, Finsbury Sq., London, E.C.; France, by Markt & Co. Ltd., 107 Avenue Parmentier, Paris; Germany, Austria-Hungary and Scandinavian Countries by Ludw. Loewe & Co., Hutten Strasse 17-20, Berlin.

REACTO Electric Horn

Not abruptly harsh in tone, but loud, sustained and penetrating—strong throughout. Permanent adjustment. DUST AND WATERPROOF EASY TO KEEP CLEAN

Send for Bulletin 851 Now

The Holtzer-Cabot Electric Co.
Chicago, Ill. Brookline, Mass.

GROBET SWISS FILES

and other high-class Tools are shown in "THE TOOL-MONGER"—its 375 pages, and will be mailed on receipt of 6 cents in stamps.

MONTGOMERY & CO.
105 Fulton Street New York City

ELECTRIC MOTORS Dynamos
SPECIAL MACHINES Grinders Polishers

ROTH BROS. & CO.
198 Loomis Street, Chicago, Ills.

GET YOUR SHARE

Large profits—easiest—fastest—biggest seller on the market today. National Self-Heating Gasoline Iron sells everywhere—town or country. Join our force of enthusiastic agents now. No time to lose. Complete demonstrating outfit, $4.50. Write for the facts.

National Stamping & Electric Works
402 S. Clinton Street, Chicago, Illinois

STUDY LAW

High-Grade Instruction by Correspondence

Prepares for the bar. Three Courses: College, Post-Graduate and Business Law. Nineteenth year. Classes begin each month. Send for catalog giving rules for admission to the bar of the several states.

Chicago Correspondence School of Law
506 Reaper Block, Chicago

LEARN TELEGRAPHY

MORSE and WIRELESS at home with OMNIGRAPH AUTOMATIC TEACHER in half usual time—trifling cost. Sends you messages without limit automatically—easily become expert. Price $2.00. Catalog free. OMNIGRAPH MFG. CO. Dept. 16. 39 Cortlandt Street, New York.

CORRECT INFORMATION

is a vital necessity to every man in the dry goods trade. His success absolutely depends upon it. The

Dry Goods Merchandiser
15 E. 26th Street New York

authoritatively forecasts fashions and accurately reports all wholesale markets within its field. It also publishes a raft of special articles teeming with human interest, yet of practical help to the trade. Profusely illustrated.

ONE DOLLAR A YEAR Send for Sample Copy

PANAMA CANAL AND WEST INDIES WINTER CRUISES

JAN 16 28 DAYS $175 Up
FEB 20
MAR 27 16 DAYS $145 Up

NORTH GERMAN LLOYD
5 BROADWAY OELRICHS & CO., GEN'L AGENTS NEW YORK
H. CLAUSSENIUS & CO. CHICAGO
CENTRAL NATIONAL BANK ST. LOUIS
GALLOWAY & CHAMPION WINNIPEG
R. CAPELLE SAN FRANCISCO

necessary to leave Britain in order to spend holidays in pleasant and picturesque surroundings. The beauties of southern England are almost matchless, and this book furnishes an admirable key to all.

HANDBOOK OF SHOEMAKING. By William H. Dooley, Principal of the Lowell Industrial School. With 41 illustrations. 12mo.; cloth. Price, $1.50 net. Boston: Little, Brown & Co., 1912.

In the preface to this book Mr. Dooley tells us that in 1908 he was asked by the Lynn Commission on Industrial Education to make an investigation of European shoe schools and to assist the Commission in preparing a course of study for the proposed shoe school in the city of Lynn. A close investigation showed that there were several textbooks on shoemaking published in Europe, but that no general textbook on shoemaking had been issued in this country adapted to meet the needs of industrial trades and schools, or those who have just entered the rubber, shoe, and leather trades. This book has been written to meet this need. The author begins with the history of footwear, its adaptation in conformance to the anatomy of the foot, and its growth to the present industrial stage. Then he describes leathers, the various methods of tanning, the manufacture and repair of the different kinds of shoes, together with the allied industries of rubber footwear and kid glove manufacture. The result of the author's European trip is reflected in a comparison between European and American methods. As might be expected, America is far in the lead. It must be stated, however, that recently American shoe machinery has been introduced into Europe, with the result that European methods and products are fast changing for the better. The list of chapter headings is as follows: Fundamental Shoe Terms; Hides and Their Treatment; Processes of Tanning; the Anatomy of the Foot; How Shoe Styles are Made; Departments of a Shoe Factory; McKay and Turned Shoes; Old-fashioned Shoemaking and Repairing; Leather and Shoemaking Terms; Leather Products Manufacture; Rubber Shoe Manufacture and Terms; History of Footwear.

A POPULAR GUIDE TO MINERALS. By L. P. Gratacap, A.M. New York: D. Van Nostrand Company, 1912. 8vo.; 330 pp.; map in pocket book. Price, $3.

All who have ever visited the American Museum of Natural History and seen the arrangement of the minerals, must have wondered at the erudition of the curator, Prof. Gratacap. It has one of the best arranged mineralogical collections in the world, as well as being one of the best. Therefore, when Prof. Gratacap starts out to combine a popular guide to minerals and a description of the collection under his care, we have a happy combination. This is a scientific book of high order. Popular guides to minerals are legion, and their distinguishing quality is usually their looseness of statements. The present book, however, shows the hand of the experienced mineralogist, who is familiar not only with the theoretical part of the subject, but with the actual specimens as well. Prof. Gratacap's opportunities have been very exceptional for study, and he has not neglected them in any degree. The volume before us is a handsome piece of book making. It is filled with half-tone engravings, mostly from the Bement collection in the American Museum of Natural History. The subjects which have been selected for illustration are excellent, and the plates do justice to the minerals as well as they can in monochrome. There is an excellent example of color printing of a mineral—rhodonite—which is used as a frontispiece. The book will be of great use to visitors to public cabinets of minerals, and for elementary teaching in mineralogy. There are four hundred text illustrations and seventy-four photographic plates. There is also a map in a pocket in the cover of the book, which shows the distribution of minerals in the United States. It is a happy addition to the literature of mineralogy.

HANDBUCH FÜR HEER UND FLOTTE. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten, Generalleutnant z. D. Unter Mitwirkung von mehr als 200 der bedeutendsten Fachautoritäten. Vollständig in 108 Lieferungen reichillustrierten Textes mit farbigen Beilagen, Karten, Plänen, Gefechtsskizzen usw. Deutsches Verlagshaus Bong & Co. Preis jeder Lieferung 2 Mark = K. 2.40.

Installment No. 48 brings to a close special Volume IX on "Wars." Generalfeldmarschall Dr. Freiherr von der Goltz discusses the Greek-Turkish war of 1897. His account is illuminating because it shows what are the events that lead two modern powers to engage in war. Other excellent articles in this installment are devoted to the part that the German troops played during the Boxer uprising of 1900 and 1901, and the German colonial wars in South Africa, between 1903 and 1907. To Americans, the account of the Spanish-American war of 1898 will be of interest. Naturally both American and Spanish ineptness are criticised. Other conflicts that are discussed in the installment deal with the Boer war of 1899-1902, the Somaliland campaign of 1901-1904 against the Mad Mullah, the Turkish disturbances of 1903-1911, and the Russian-Japanese war of 1904-1905. This last war is particularly interesting to the military student, because it was the last great conflict in which enormous armies were opposed to each other and in which important naval actions took place. Splendid military charts are to be found in the installment. An excellent index has been supplied by Rechnungsrat Scheffler, which renders it easy to use the volume for reference.

For Scientific Cleaning
For removing gummy accumulations on machinery and spattered oil and grease on woodwork and flooring, Old Dutch Cleanser has no equal. Thoroughly frees the hands from all stains; scientific instruments cleaned easily and antiseptically. Keep a can handy.
Old Dutch Cleanser
Many Uses and Full Directions on Large Sifter-Can 10c.

Encyclopædia Making is Now at an End!

For twenty years Encyclopædia publishers have been trying to produce a Loose-Leaf Encyclopædia—knowing this to be the only way to keep an Encyclopædia always up to date and have a work that would NEVER GROW OLD. The great difficulty has been to invent a Loose-Leaf binder that would be appropriate for a library volume.

NELSON'S
Perpetual Loose-Leaf
ENCYCLOPÆDIA
& Research Bureau for Special Information

Has Solved the Problem!

That Little Bar and Nut has solved the problem. It has put all other Encyclopaedias out of date!

Bound in 12 Handsome Volumes

In 1907, Thomas Nelson & Sons—established for over a hundred years in Edinburgh, Scotland—perfected and patented a Loose-Leaf Binder, a volume so practicable that by simply turning a nut the pages are loosened, when the old and obsolete pages can be easily removed and the new pages substituted. The publishers issue to subscribers, twice a year, not less than 250 revised pages—in March and in October—thereby making Nelson's Encyclopædia *always new* and abreast of the times. By means of the Loose-Leaf binding device, Nelson's Encyclopædia contains the very latest information, while the other Encyclopædias quickly grow old.

NELSON'S IS THE ONLY AUTHENTIC AND RELIABLE ENCYCLOPÆDIA because it is the only one that is new and can be kept new.

NELSON'S RESEARCH BUREAU supplies—FREE—any special information required by owners of Nelson's Encyclopædia—the ONLY institution of its kind in the world!

With NELSON'S LOOSE-LEAF ENCYCLOPÆDIA and the services of NELSON'S RESEARCH BUREAU FOR SPECIAL INFORMATION you have at your command—positively guaranteed to you—all the available information and knowledge of the world.

Upwards of a million dollars have been spent and more than 1,200 specialists in all parts of the world engaged to make Nelson's the supreme authority for those who know or who want to know. Nelson's has been approved and adopted as an authority by U. S. Government Departments, Universities, Colleges, Libraries and School Boards throughout the country.

NELSON'S contains a complete account of the Parcels Post Law, Dictograph, British National Insurance Law, Olympic Games, Boss Rule, etc., etc.

If You Buy NELSON'S You will never Need to Buy Another

Following are among the U. S. Departments and Colleges now using Nelson's:

Bureau of Chemistry	War Department	University of California	Reclamation Service
Department of Justice	Indian Bureau	University of Michigan	Chief Signal Office
Commerce and Labor	Bureau of Corporations	Weather Bureau	Harvard University
Department of State	National Museum Library	Navy Department	Knox College
Cornell University	University of Rochester	Army Service School	Public Libraries

NELSON'S ENCYCLOPÆDIA is endorsed by newspapers, magazines, scholars and literary workers in all parts of the world. Following are a few examples of thousands on file:

J. G. Schurman, President of Cornell University, says: I have made constant use of my set of your Encyclopædia and find it pre-eminently satisfactory."

The Review of Reviews says: "Nelson's is used as the authority in our Editorial Rooms."

The New York Evening Post says: "All in all, the treatment of the subject matter in Nelson's is an admirable example of compression, and fulfils to an unusual degree the purpose of the editors."

The New York Times says: "Nelson's never grows old, is never antiquated. It will give answer years after its publication to the most modern of queries."

The New York Independent says: "It is safe to say that the owners of Nelson's are the only ones whose Encyclopædia contains accounts of recent events. We find it indispensable."

Dep. 21 L

Before I decide on any Encyclopædia, please send me portfolio containing sample pages and full information in regard to NELSON'S LOOSE LEAF PERPETUAL ENCYCLOPÆDIA AND RESEARCH BUREAU FOR SPECIAL INFORMATION. *This incurs no obligation whatever on my part.*

Name.....
Address.....
City..... State.....

EXCHANGE A liberal allowance will be made on old Encyclopædias to apply as part payment on Nelson's.

THOMAS NELSON & SONS
Published Since 1798
Dept. 21L, Fourth Ave. Building, Cor. 27th St., New York City

Landmarks of Typewriter Progress

Such are all the recent developments of the

Remington

VISIBLE MODELS
10 and 11

Among these developments are:

The Built-in Decimal Tabulator — which makes the decimal tabulating mechanism an integral part of the typewriter.

The Tabulator Set Key— which eliminates all hand setting of the tabulator stops.

The Column Selector— which determines, by the stroke of a single key, the exact point on each line where the writing is to begin.

The Adding and Subtracting Remington
(Wahl Mechanism)—which combines in one typewriter, ***and in one operation,*** the functions of the writing machine and the adding machine.

Every one of these new developments is an evidence of the perpetual leadership of the Remington Typewriter. Illustrated booklet, descriptive of all recent Remington improvements, sent on request.

Remington Typewriter Company
(Incorporated)
New York and Everywhere

One of the Squadrons of Twenty-four White Motor Trucks Owned by Armour and Company, Chicago, and Operated by them in the Principal Cities of the United States

WHITE MOTOR TRUCKS

The predominant use of White Motor Trucks by the foremost mercantile and manufacturing firms, not only in the United States, but throughout the world, is the most convincing proof of their superior merit in practically every line of service.

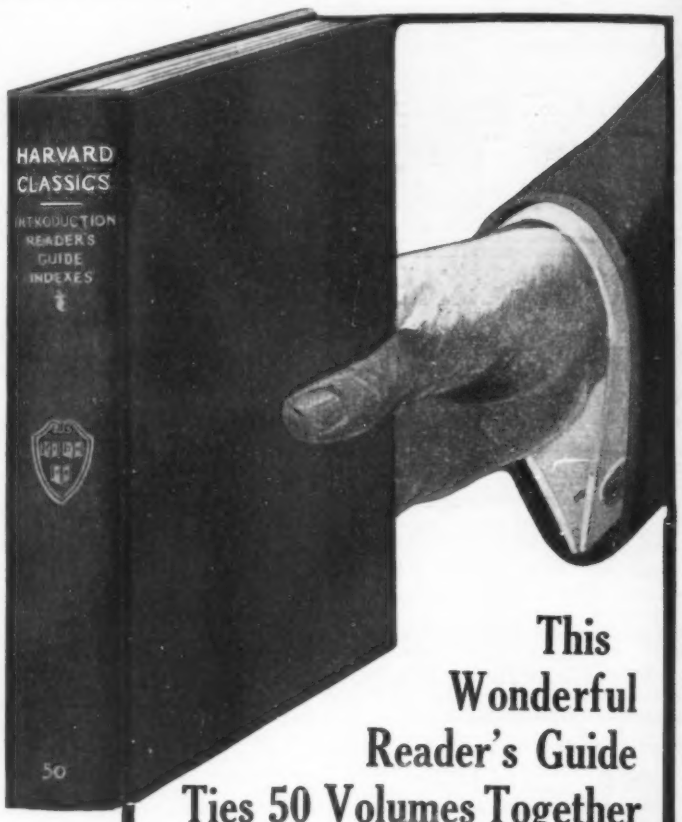
A Few Well-Known Owners of White Squadrons

American Can Company	Joseph Horne Company
American Chicle Company	Hudson's Bay Company
American Steel and Wire Company	Illinois Steel Company
Armour and Company	McCreery and Company
Berghoff Brewing Association	National Cash Register Company
Booth Fisheries Company	Pabst Brewing Company
Brazilian Government	Philippine Islands Government
Coca-Cola Company	Postum Cereal Company, Ltd.
Cudahy Packing Company	Remington Typewriter Company
Diamond Rubber Company	Russian Government
T. Eaton and Company, Ltd.	W. and J. Sloane
Marshall Field and Company	Standard Oil Company
Gimbel Brothers	United Cigar Stores Company
B. F. Goodrich Company	United States Government
Gulf Refining Company	Winchester Repeating Arms Company

White Motor Trucks are built in capacities of 3-4, 1 1-2, 3 and 5 tons, and all models are uniform throughout in parts and design, thus making them the most practical for the standardization of delivery or transportation service. Literature and detailed information furnished on request.

Gasoline Motor Cars, Trucks and Taxicabs

The White Company
Cleveland



This Wonderful Reader's Guide Ties 50 Volumes Together

Dr. Eliot's plan, from which the Five-Foot Shelf has been evolved, was to collect in fifty volumes, in the limits of an ordinary bookshelf, a complete summary of the world's intellectual growth, as represented by the greatest philosophers, scientists, poets, dramatists, historians and story-tellers.

It was, in short, a plan to put "the world's civilization on a bookshelf."

But without this ingenious "Reader's Guide" the Five-Foot Shelf would have been simply a splendid collection of literature, each volume standing by itself.

The "Reader's Guide" turns these fifty volumes into one great book. The "Guide" shows the reader how to follow a single thought through the entire library, to take a consensus of opinion of the world's greatest thinkers.

Dr. Eliot's Five-Foot Shelf

The Harvard Classics

We have just published a Popular Edition of this famous library. In publishing this edition we are carrying out Dr. Eliot's idea of the place this library should permanently hold as an educational influence. He intended the Five-Foot Shelf for the millions of men and women who are busy doing the nation's work, and who have no time to read a roomful of books to gain a clear perspective of the world's thought and achievement.

The Popular Edition is sold at a low price, and on easy terms that put it within everybody's reach.

Have You Sent Us Your Free Book Coupon?

If you have not yet received our attractive 64-page book describing the Five-Foot Shelf, cut out the coupon and mail it to us today.

We will send the book by return mail. It contains full information about the Five-Foot Shelf, its plan and purpose and contents.

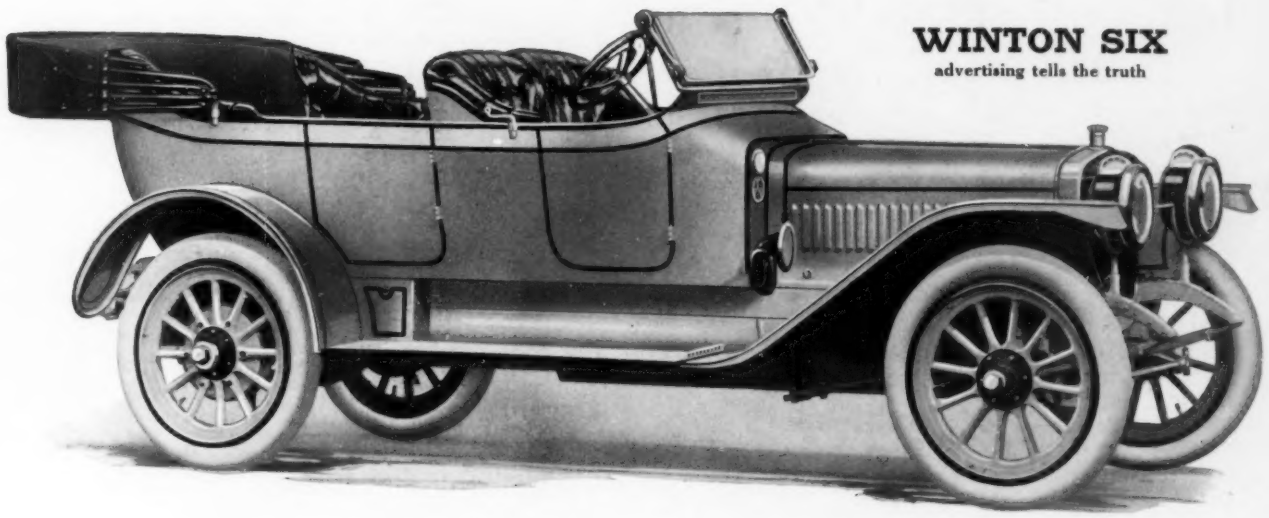
P. F. Collier & Son, Inc.
Publishers of Good Books
New York

Sci. Am. 11-9

P. F. Collier & Son, Inc.
416 W. 13th St., New York

Please send me by mail, free of charge, the 64-page book describing the Harvard Classics, Dr. Eliot's Five-Foot Shelf of Books.

Name .....
Street .....
City .....
State .....



America's Foremost Car

THE American gasoline automobile industry is less than fifteen years old. It was established by Alexander Winton in March, 1898.

¶ In the first nine years of the industry, four types came along in rapid succession—one, two, three, and four-cylinder cars.

¶ In the tenth year of the industry (June, 1907), when Mr. Winton became the world's first maker of Sixes exclusively, he produced a record-breaking, history-making car—the Winton Six.

SELF-CRANKING

It was the world's first self-cranking car. The industry has followed Mr. Winton's lead.

LOWEST REPAIR COST

It established, and has maintained from year to year, the world's lowest record of repair expense cost. The present figure is 22.8 cents per 1000 miles. All sworn figures.

PROVED SIX SUPERIORITY

It proved the six-cylinder car superior to all other types, and forced the industry to adopt Sixes. The present six-cylinder era is the result.

FREE FROM FAULTS

This same Winton Six is now in its sixth year of success. Its body lines and seating arrangements are new, but the motive part of it has not required a single radical change in these six years. This record has no parallel.

UP TO THE MINUTE

Any car that can live through two seasons without extensive changes is an exceptional car. But the Winton Six has outdone exceptional cars three times over. Its freedom-from-faults has made it the leader through nearly half of the life of the industry, and it is today up-to-the-minute in everything that makes a high-grade car worth having.

PRICE LEADERSHIP

Nor does the leadership of the Winton Six stop with pioneership, proved excellence as to type, proved endurance and stability, and the world's record for freedom from faults. Winton Six leadership also includes price.

WORLD'S GREATEST VALUE

By the same efficiency in business management that characterizes Winton Six designing and manufacturing, the Winton Company has avoided watered stock, funded debts, and other burdensome charges that force up the price but do *not* make a car look finer, run better, or last longer.

All the quality any car can have at a price of $3000 makes the Winton Six the greatest motor car value in the world. Let us send you our latest catalog.

Please send me the catalog advertised in the Scientific American.

.....

.....

.....

To the WINTON CO.
1080 Berea Road, Cleveland, Ohio

The Winton Motor Car Co.

The World's First Maker of Sixes Exclusively — **Cleveland, Ohio**

Winton Branch Houses: NEW YORK: Broadway at 70th St.; CHICAGO: Michigan Avenue at 13th St.; BOSTON: 674 Commonwealth Ave.; PHILADELPHIA: 246-248 N. Broad St.; BALTIMORE: Mt. Royal at North Ave.; PITTSBURGH: Baum at Beatty St.; CLEVELAND: 1228 Huron Road; DETROIT: 998 Woodward Ave.; MILWAUKEE: 82-86 Farwell Ave.; MINNEAPOLIS: 16-22 Eighth St., N.; KANSAS CITY: 3324-3326 Main St.; SAN FRANCISCO: 300 Van Ness Ave.; SEATTLE: 1000-1006 Pike St.

This educational advertising has helped, and is helping old and young to Good Teeth-Good Health
COLGATE'S RIBBON DENTAL CREAM
Clean teeth a matter of common sense
COLGATE'S
RIBBON DENTAL CREAM
The Gulf of Good Teeth
ENLIST
COLGATE'S RIBBON DENTAL CREAM
Leave a sentry on guard over your teeth
"For baby gums, to help the teeth
THE GREAT TUBES
Made Over and Under the Hudson
COLGATE'S RIBBON DENTAL CREAM
TAKE THE TUBE HOME
COLGATE'S RIBBON DENTAL CREAM
Comes out a ribbon flat on the brush
If you are one of those who are looking for an efficient dentifrice without a "druggy" taste, try—
COLGATE'S RIBBON DENTAL CREAM
—and assure yourself that its delicious flavor does not lessen its efficiency. Ask your dentist, or notice for yourself the difference in your teeth after a month or two of its twice-a-day use.
CONSERVATION
THE saving not only of national, but of personal resources is important.
COLGATE'S RIBBON DENTAL CREAM
COLGATE'S RIBBON DENTAL CREAM
CANNOT ROLL OFF THE BRUSH
COMES OUT A RIBBON ON LIES FLAT ON THE BRUSH
DELICIOUS
ANTISEPTIC
ECONOMICAL

Our Teeth are Better than Our Parents' Teeth

Fifty years ago there was little known about the care of the teeth. The manufacturers of the few dentifrices then on the market did as best they could—and their preparations in spite of grit and "druggy" taste did some good. The grit served to clean teeth which never had known cleanliness, even though it scratched them too. The medicine taste appealed to those who thought nothing that *tasted good* could *do* good.

Within the past few years people have come to a realization that proper care of the teeth demands a dentifrice *without grit*—and that the teaching of children to care for their teeth demands a pleasant tasting dentifrice.

And so we have come to

COLGATE'S RIBBON DENTAL CREAM

Here then is a real dentifrice:

It cleans thoroughly, safely. There is no druggy taste—it is not over-medicated. Over-medication is frowned upon by dentists and their patients. A pleasant taste is recognized as an advantage in starting young people on the road to Good Teeth—Good Health. Ribbon Dental Cream is an easy riding vehicle on that road.

To Mothers, Dentists and Other Teachers

Regular care of the teeth by young people now will avoid years of regret later on. We do not go so far as the New York Times, which said in a recent editorial:

> "A boy whose teeth are bad, whose mouth and throat are swollen and germ-laden, whose nasal, oral and ocular passages are stopped up, blinks when he looks at the blackboard, fails to hear his name when called upon, is bowed by defective breathing, and is pained in digestion. He becomes a truant, rebellious and a liar. Give him an oral cleansing and complete masticatory repairs, and you begin to make of him a gentleman and a scholar." [The underlining is ours]

We quote this, although we do not agree that neglected teeth necessarily make a child untruthful. But we do say that good teeth are necessary for good digestion, —good digestion is necessary for good health.

So that more may know Ribbon Dental Cream, a trial tube (formerly 4c.) will now be sent for a 2c. stamp. If you wish our instructive "Oral Hygiene" merely say "Send the Book." It is free.

COLGATE & COMPANY

Dept. 70 199 Fulton Street New York

Makers of Cashmere Bouquet Soap—luxurious, lasting, refined